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THORACIC STOMACH: DIFFERENTIATION FROM EVENTRATION AND HERNIA OF THE DIAPHRAGM [1]

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ALTHOUGH a number of recent articles have been written on the subject of hernia of the diaphragm [2] and eventration of the diaphragm,[3] little attention has been directed toward the study of thoracic stomach. Thoracic stomach is the name given by P. Bailey [4] to designate the congenital development of the stomach above the diaphragm. Bailey's case was encountered in the dissecting room. A careful perusal of Bailey's description of the anatomical findings in his case convinces one that it is necessary to draw a sharp distinction between thoracic stomach and hernia of the diaphragm (Figs. 1 and 2). The absence of any false opening in the diaphragm bears this out in his case. While anatomists may not entirely agree as to the way in which this anomaly occurs, all the evidence supports the theory that the stomach has never been below the diaphragm. This is borne out particularly by the very short esophagus,[5] which is entirely above the diaphragm (Fig. 3). The pyloric end of the stomach or the first portion of the duodenum passes through a small opening in the diaphragm corresponding to the normal opening for the esophagus. The surrounding portion of the diaphragm closes the opening completely except for a small area occupied by the pyloric end of the stomach or the first portion of the duodenum, leaving no room for hernial protrusion. It is, therefore, absolutely erroneous to designate this condition as hernia of the diaphragm when no hernia actually exists. One might compare this diagnosis to the erroneous labeling of a non-rotation of the colon with the cecum and the appendix on the left side, as a transposition of the viscera, the two conditions having absolutely nothing in common in their origin, although the cecum and appendix are on the left side in both cases, the origin of the anomaly in non-rotation being due to a faulty development in the mesocolon, while the transposition of the viscera, according

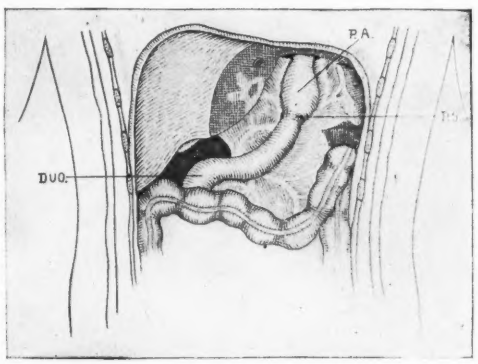

Fig. 1. Thoracic stomach. Anterior view of upper part of abdomen. The left lobe of the liver has been removed. P. A., pyloric antrum; P. S., pyloric sphincter; DUO., duodenum (Bailey).

[1] Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923.

[2] M. B. Clopton. Annals of Surg., Aug., 1923, p. 154.

[3] P. M. Stimson. N. Y. State Journal of Med., Oct., 1923, p. 408.

[4] P. Bailey. Anat. Record, Oct. 20, 1923, XVII, No. 4, pp. 101-109.

[5] S. Fineman. Right Diaphragmatic Hernia of the Short Esophagus Type. Am. J. Med. Sc., 1924.

to the theory of some biologists, is related to the formation of identical twins, one of which fails to develop.

On the other hand, in true hernia of the diaphragm, the normal esophageal opening exists and there is a defect or absence of a

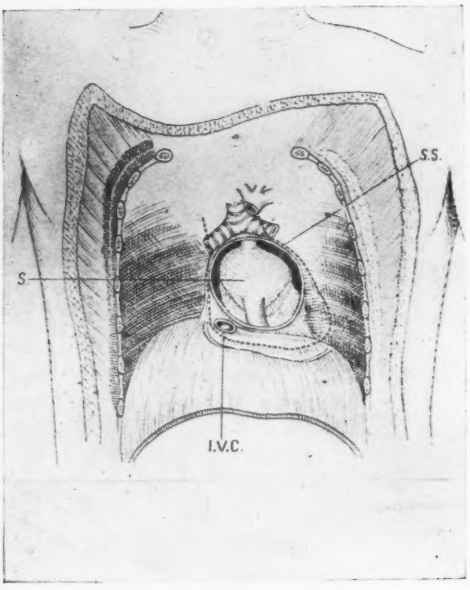

Fig. 2. Thoracic stomach. Anterior view of thorax. Lungs and heart removed and serous sac surrounding stomach opened. Position of heart indicated by dotted line. S., stomach; S. S., serous sac around stomach; I. V. C., inferior vena cava (Bailey).

portion of the diaphragm through which the stomach and sometimes other abdominal viscera pass into the thoracic cavity. The condition, therefore, is distinguished roentgenologically by demonstrating the fact that the esophagus goes through the diaphragm and then enters the stomach below the diaphragm, while *in thoracic stomach the esophagus never passes through the diaphragm at all.* The roentgen examination also reveals the fact that in hernia of the diaphragm the stomach may be found at times entirely or partly above the diaphragm, and at other times partly or wholly below the diaphragm, while in thoracic stomach the stomach is always above the diaphragm. Furthermore, in hernia of the diaphragm, other abdominal organs beside the stomach are frequently found in the chest cavity, while in thoracic stomach no other abdominal organ is ever found above the diaphragm.

Hernia of the diaphragm through the esophageal opening has been encountered

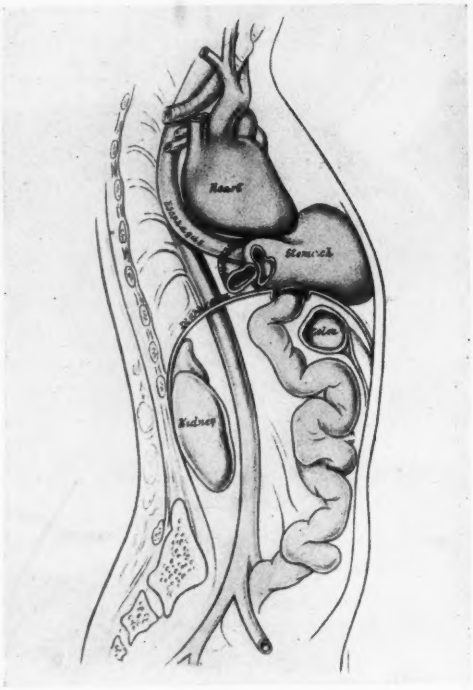

Fig. 3. Thoracic stomach. Diagram of Case 1 from findings at operation by Dr. W. A. Downes. Note entrance of esophagus into stomach above diaphragm. The artist has apparently placed the stomach too far forward, for in Case 2 the stomach is distinctly shown behind the heart (Fig. 7).

in two cases (Fig. 8). In these cases there was a small protrusion of a portion of the stomach alongside the esophagus. This appearance was not constant and when present, in one of the cases, was associated with a peculiar spasmodic cough for which the patient had consulted a laryngologist who referred the case to me for roentgen examination.

Hernia of the right side of the diaphragm is a much rarer condition (Fig. 9). Of 635 cases of diaphragmatic hernia collected by Eppinger, 580 were left-sided and only

Fig. 4. CASE 1. Thoracic stomach. Age 7 years. After gastro-enterostomy. Note the stomach is entirely above the diaphragm and shows two gas bubbles at slightly different levels. The opaque substance is passing through the diaphragm in the region of the usual esophageal opening.

55 right-sided. One case of this sort has been encountered in which the hepatic flex-

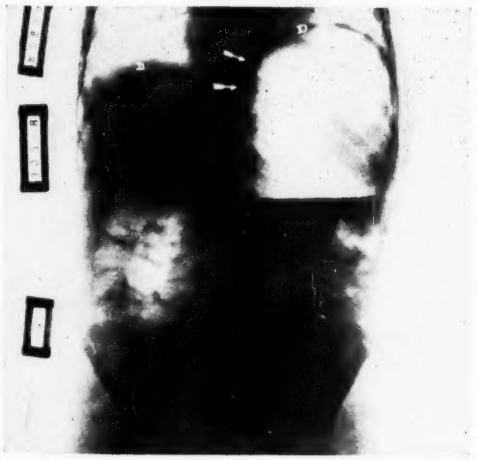

Fig. 5. Eventration of diaphragm. Age 4 years. This confirms the opinion that eventration of the diaphragm is of congenital origin.

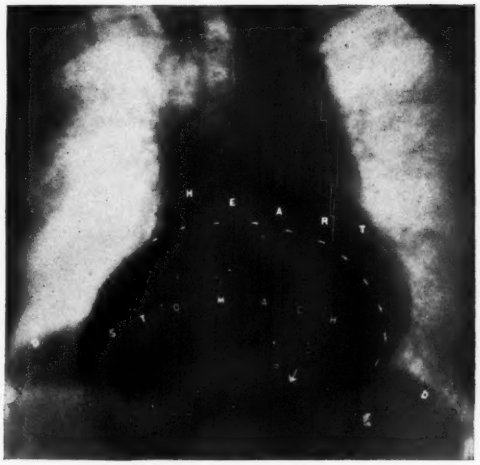

Fig. 6. CASE 2. Thoracic stomach. Age 69 years. Note entire stomach above the diaphragm.

ure of the colon had entered the thoracic cavity on the right side behind the liver. This was confirmed by surgical exploration by Dr. W. A. Downes.

Complete absence of the left half of the diaphragm has been described and was encountered in one case, a description of

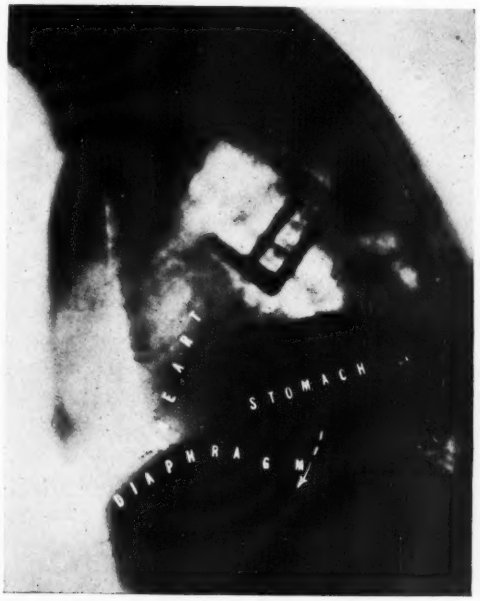

Fig. 7. CASE 2. Thoracic stomach. Lateral. Note stomach behind the heart and entirely above the diaphragm.

which follows (Figs. 10, 11, 12). In this particular case, with the exception of a small portion of the colon, the stomach was the one hollow viscus which remained in the abdominal cavity, the jejunum, ileum, cecum, appendix and all of the colon except

Fig. 8. Case 5. Hernia of stomach through the esophageal opening. Note absence of usual gas bubble at cardiac end and a portion of the stomach above the diaphragm. On fluoroscopic study it was observed that the patient, by forcibly contracting the abdominal muscles, could cause a portion of the cardiac end of the stomach to pass into the chest cavity through the esophageal opening.

the descending portion and sigmoid being in the chest cavity.

Eventration of the diaphragm can always be distinguished roentgenologically from thoracic stomach by the fact that the diaphragm on the left side, no matter how much thinned out or however high in the chest cavity it may be, can always be demonstrated above the stomach (Fig. 13). Exposure in the lateral position is essential in making this differentiation (Fig. 14).

Eventration of the diaphragm on the left side is believed to be of congenital origin and due to the absence of muscular structure in the diaphragm. The condition has been observed roentgenologically in infants. Fig. 5 illustrates a child four years of age.

Bilateral eventration of the diaphragm has been encountered seven times and was

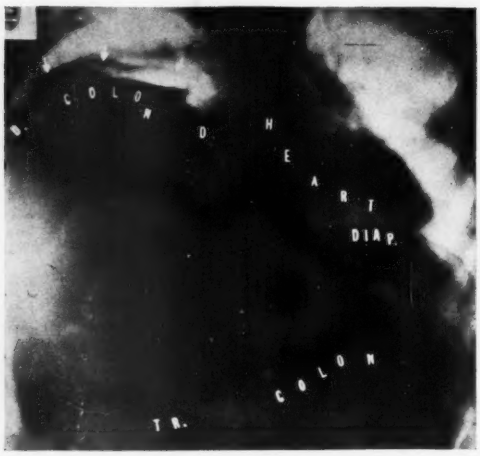

Fig. 9. Case 6. Hernia of the diaphragm on the right side. Age 40. Note that part of the colon appears above the diaphragm on the right side. Lateral exposures show the defect in the diaphragm to be posterior to the liver. Confirmed by operation.

associated with megacolon in all cases (Fig. 15). In the radiographs of these cases it is difficult to identify the shadow of the liver because the superimposed gas-filled dilated colon allows the rays to penetrate the liver in such a way as to almost completely obliterate its outline. Lateral examination may be the only means of ascertaining the position of the liver.

Subphrenic abscess with the presence of gas beneath the diaphragm should never be confused with eventration of the diaphragm. The history of the case will usually be a guide (Fig. 16).

In medico-legal cases it is extremely important to recognize the congenital nature of thoracic stomach as well as the congenital types of hernia of the diaphragm and eventration of the diaphragm. In a recent case,[6] in which a boy was struck by an automobile, it was contended that the presence of some of the abdominal organs in the

[6]Judge Erlanger. Supreme Court, New York State. 1923.

Fig. 10. CASE 7. Congenital absence of left half of diaphragm. Male, age 30. Note that no portion of the left side of the diaphragm can be made out. See lateral exposure (Fig. 11). Proximal half of colon is in chest cavity on left side. Heart is displaced to right.

chest cavity, for which compensation to the extent of $75,000 was asked, resulted from the accident. It was, however, the verdict of the jury, in view of the evidence submitted, particularly the absence of shock following the injury, and the fact that numerous cases of congenital hernia of the diaphragm had been recorded giving an identical radiographic appearance with that of the plaintiff in this case, that the condition was of congenital origin.

In view of the frequency of these congenital anomalies, it is advisable to regard a particular case in which an abdominal viscus is found in the chest cavity, as congenital in nature, unless there is overwhelming evidence that the condition has been acquired. This would almost necessi-

Fig. 11. CASE 7. Congenital absence of left half of diaphragm. Lateral. Note large amount of colon in chest cavity.

tate X-ray evidence of a normal thorax previous to the alleged injury, or operative evidence, at which time a section of the margin of the supposed rent in the diaphragm, when submitted to microscopic examination, reveals absence of normal endothelial covering. It is important to realize that it is possible, in almost any case, to obtain a history of injury *theoretically* capable of producing a hernia of the diaphragm, such as being dropped in infancy, falling down stairs, violent coughing, etc. However, in an extremely small percentage of these cases a hernia of the diaphragm is produced.

THORACIC STOMACH

Case 1. N. C., m., age 7. Referred by the Surgical Service of St. Luke's Hospital,

Dr. W. A. Downes. Patient was emaciated and complained of inability to take food in satisfactory amounts, vomiting and failure to gain weight. Duration, five and one-half years. He had a severe convulsive seizure at one and a half years and had been dropped down one flight of stairs at two years. (A history of injury in a case of this type should always be investigated carefully, for, as previously mentioned, it is possible to obtain a history of fairly severe accident at some time in the life of almost every individual.)

Fig. 12. CASE 7. Congenital absence of left half of diaphragm. Note that the stomach is in the abdominal cavity, while practically all the rest of the hollow viscera are in the chest cavity. The duodenum passes directly upward and merges with the jejunum, which is within the chest.

Physical examination showed the chest to be of peculiar shape, long and narrow, with the heart displaced to the right.

Roentgen examination showed the stomach to be above the diaphragm (Fig. 4). It emptied very slowly. A bismuth enema showed the colon to be of normal size and location. Dr. Downes performed an anterior gastro-enterostomy through the esophageal opening January 4, 1918, and demonstrated that the stomach was entirely above and resting upon the diaphragm (Fig. 3). No attempt was made to place the stomach in the abdominal cavity; in fact, this would probably have been impossible on account of the short esophagus.

Case 2. M. P., f., age 69. Referred by the Medical Service of St. Luke's Hospital, Dr. Lewis Frissell. Patient complained of severe pain in the epigastrium for five years, with indefinite distress for thirty years. Was run over by a horse and wagon twenty years previous to examination. (In our opinion, this injury had no connection with the presence of the stomach in the chest.)

Roentgen examination showed the entire stomach within the chest cavity (Fig. 6). The esophagus was very short and entered the stomach in about the median line without any obstruction. The stomach emptied slowly through the opening in the diaphragm to the left of the median line. The heart was not displaced. There was no evidence of any other abdominal organ in the chest cavity. There was retention of about one-tenth of the meal in the stomach at six hours.

Comment. After the position of the stomach was noted, the patient was asked to place her hand where she felt distress when suffering from "indigestion." She placed her hand over her chest in the exact position in which the stomach was located and stated that she had repeatedly told physicians that she could feel her stomach in this place but was always ridiculed.

HERNIA OF THE LEFT SIDE OF THE DIAPHRAGM

Case 3. J. S., m., age 52. Referred by Dr. Otto Hensel. Two years previous to examination the patient was supposed to have had ptomaine poisoning with diarrhea. There was gas distention, relieved by castor oil. Numerous attacks followed. He was put on a diet, with relief of pain. Be-

tween the attacks he claimed to feel very well.

Roentgen examination showed definite evidence of a part of the stomach in the chest cavity behind the heart. A fluid level within the stomach could be made out above the diaphragm. There was partial constriction of the stomach where it passed through the diaphragm. The lower pouch was considerably larger than the upper. There was no delay in the emptying of the stomach. Injection with opaque mixture showed that the colon did not appear to pass through the diaphragm.

Comment. The symptoms in this case apparently were associated with the presence of the stomach above the diaphragm. In the intervals when the patient was free from distress the stomach probably was entirely below the diaphragm. This opinion is strengthened by the fact that at one previous X-ray examination the stomach findings were reported negative. Three months later, a second roentgenologist reported that part of the stomach was above the diaphragm. Both roentgenologists were apparently correct in their statements. The writer was appealed to for a decision. Fortunately, at the time of examination part of the stomach was found above the diaphragm, so that the diagnosis of hernia was confirmed. In the absence of any history of trauma, it is believed that this case represents a congenital hernia.

PARTIAL PROTRUSION OF THE STOMACH THROUGH THE DIAPHRAGM AT THE ESOPHAGEAL OPENING

Case 4. G. F., m., age 48. Referred by Dr. John McCoy. The patient gave a history of being in a wreck two or three years previous to examination in which an injury to the jaw was received. There had been asthmatic attacks for a year and a peculiar heavy feeling in the upper left abdomen. Several operations had been performed on the nasal sinuses.

Roentgen examination.—It was observed fluoroscopically that there was an irregularity about the inner portion of the left side of the diaphragm. After the administration of an opaque meal it was found that the abnormal appearance about the diaphragm was due to the protrusion of a portion of the stomach through the esophageal opening. In the standing position, the usual gas bubble observed at the cardiac end of the stomach could be made out above the diaphragm close to the esophagus. The colon did not appear to pass through the diaphragm but was exceedingly high in position with a "horseshoe" shape. Teleoroentgenogram showed the heart and aorta to be of normal size and appearance.

Comment. It is believed that the peculiar attacks simulating asthma were due to the presence of a portion of the stomach alongside the esophagus, just as in cardiospasm when the esophagus is unduly distended in this region a peculiar cough is apt to be present.

HERNIA OF THE DIAPHRAGM THROUGH THE ESOPHAGEAL OPENING

Case 5. L. K., f., age 44. Referred by the Out-patient Department of St. Luke's Hospital. Patient had the sensation of a lump moving up and down in the chest, relieved by vomiting.

Roentgen examination showed absence of the usual gas bubble at the cardiac end of the stomach. Fluoroscopically it was observed that the patient, by a certain contraction of the abdominal muscles, could force a portion of the cardiac end of the stomach into the chest cavity through the esophageal opening (Fig. 8). No filling defect was observed in the stomach and no retention at four hours.

Comment. The peculiar sensation of fullness in the chest may have been due to the presence of a portion of the stomach above the diaphragm. The ease with which the patient vomited could be accounted for by lack of the normal sphincteric action of the cardiac valve of the esophagus.

HERNIA OF THE RIGHT SIDE OF THE DIAPHRAGM

Case 6. A. M., m., age 40. Referred by the Surgical Service of St. Luke's Hospital,

Dr. W. A. Downes. Patient complained of "indigestion" for one year.

Roentgen examination showed the stomach small, unusually high and irregular in contour. The diaphragm on the right side was exceedingly high, reaching almost to the upper border of the heart. The right half of the colon was high in position, a portion of it protruding through an abnormal opening in the diaphragm, behind the liver (Fig. 9). The first portion of the duodenum was very high in position, indicating that it was pulled or forced upward by the high position of the liver and colon, although it did not appear to enter the hernial sac. An entero-anastomosis was performed by Dr. Downes with approximation of the distal loop of the jejunum to the duodenum. At the time of operation the diagnosis of hernia of the diaphragm was confirmed.

ABSENCE OF LEFT SIDE OF DIAPHRAGM

Case 7. J. M., m., age 30. Referred by Dr. W. A. Downes. The patient gave a history of distress in the intestinal tract, with gas, starting as a chronic condition but becoming acute. During his high school period, in spite of a diagnosis of dextrocardia, he had the usual amount of athletics, such as running, football, etc. He had had several X-ray examinations for disturbance around the heart, but the condition of the diaphragm was not recognized until it was observed by Dr. L. W. Cunningham of Jacksonville, Florida.

Roentgen examination disclosed a deficiency in the left side of the diaphragm, with the entire ileum, greater portion of the jejunum, and the first half of the colon in the chest cavity (Figs. 10 and 11). This condition was apparently associated with non-rotation of the colon (Fig. 10). The stomach was ptosed, occupying an extremely low position in the abdomen (Fig. 12). In spite of the low position of the stomach and the abnormal position of the intestine, the stomach emptied in five hours, at which time the meal was entirely in the left side of the chest cavity. There was no evidence of a limiting membrane or sac about the colon. Examination of the chest showed the heart to be about 4.5 cm. to the right of the median line. The apex was obscured by an area of density which was continuous with and about equal in density to the abdomen. The left side of the diaphragm could not be made out. The trachea was slightly more to the right of the midline than is usual. Both lungs showed a normal appearance, with an unusual amount of pulmonary area on the right side.

EVENTRATION OF DIAPHRAGM

Case 8. C. F., m., age 38. Referred by Dr. Walter Bastedo. There had been intermittent attacks of pain in the abdomen since childhood, with increasing severity. For a period of five years there had been nausea and vomiting. Previous to admission to St. Luke's Hospital the case had been diagnosed as hernia of the diaphragm.

Roentgen examination showed the left

Fig. 13. Case 8. Eventration of diaphragm. Male, age 38. Autopsy revealed complete absence of muscular tissue in left half of diaphragm.

diaphragm to be exceedingly high in position, with a limited amount of excursion, indicating eventration of the diaphragm (Fig. 13). The upper part of the stomach filled first, giving the appearance of a pseudo-hour-glass stomach with two fluid levels. There was evidence of hyperperistalsis of the stomach and lack of filling of the duodenal cap, indicative of duodenal ulcer. Lateral exposure showed the diaphragm to extend up to about the second rib on the left side (Fig. 14).

At operation an ulcer was found at the pyloric end of the stomach. A gastroenterostomy was performed with an enteroenterostomy by means of a Murphy button. The eventration of the diaphragm was confirmed by palpation. There was no constriction of the stomach at the cardiac end. (The patient suffered from a respiratory difficulty and died the following day.)

Autopsy showed a diaphragm so thin and devoid of muscular structure that it was almost transparent. The condition was apparently due to a congenital absence of muscular tissue.

Microscopic examination showed the *right* side of the diaphragm to be composed of normal striated muscle fibers. The *left* side showed *no muscle*, but hyaline fibrous tissue. The lungs showed a small area of congestion and early broncho-pneumonia.

EVENTRATION OF THE DIAPHRAGM

Case 9. A. D., m., age 34. Referred by Dr. W. J. Pulley to the Edward N. Gibbs Memorial Laboratory, Bellevue Medical College. A cough for three months was the only complaint.

Physical examination was so indicative of pleuritic effusion on the left side that an exploratory puncture was advised, but fortunately not performed, as the X-ray examination revealed the true condition, that of eventration of the left side of the diaphragm.

Roentgen examination.—Fluoroscopically it was observed that there was good excursion of the right side of the diaphragm, with no appreciable excursion of the left side. The left side was 13 cm. higher than the right. The heart and trachea were displaced toward the right side. When filled with opaque mixture, the stomach was al-

Fig. 14. CASE 8. Eventration of diaphragm. Lateral. Note presence of left side of diaphragm, indicated by arrows, separate from shadow of stomach, proving the case to be eventration and not hernia.

most entirely in the left upper quadrant, with the cardiac end in close approximation to the diaphragm.

Comment. Exploratory puncture of the chest for the presence of supposed fluid should never be undertaken until an X-ray examination has been made.

EVENTRATION OF THE DIAPHRAGM

Case 10. M. G., f., age 41. Referred by the Out-patient Department of St. Luke's Hospital. No history of serious illness in the past. For several years patient had had intermittent attacks of pain in the epigastrium following meals, accompanied by a burning sensation lasting about an hour. Duration of last attack, six weeks. No

vomiting, no loss of weight, no constipation, no tarry stools nor urinary symptoms.

Physical examination showed the chest to be symmetrical, but the excursion of the diaphragm limited.

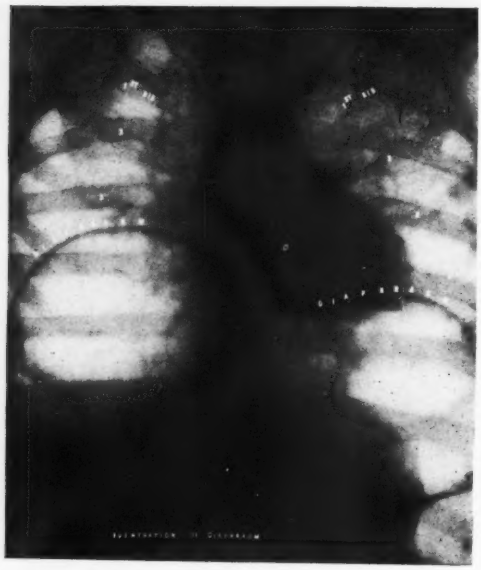

Fig. 15. CASE 11. Bilateral eventration of diaphragm. Male, age 49. Note absence of liver shadow due to superimposed colon.

Roentgen examination showed eventration of the left diaphragm. On fluoroscopic examination there was very limited movement of the left side of the diaphragm, but no limiting of the right side. The heart and mediastinal shadows were somewhat displaced to the right side. There was a large amount of gas in the stomach. Upon examination by means of an opaque meal, the stomach appeared dilated, the greater curvature about 1 inch above the umbilicus. There was an appearance of gastro-spasm involving the pyloric end of the stomach. There was no retention in the stomach at five hours. The splenic flexure was distended with gas and reached the abnormally high diaphragm on the left side, partially displacing the gas-filled cardiac end of the stomach.

The patient improved on a bland diet with bismuth subnitrate and soda bicarbonate.

BILATERAL EVENTRATION OF THE DIAPHRAGM

Case 11. A. J., m., age 49. Referred by Dr. A. H. Cilley. Since childhood patient had had difficulty in evacuation. Attacks of distention with gas. As a boy he had attacks of colic due to gas. At one time there was a volvulus of the sigmoid flexure which was relieved by Dr. Downes by passing a tube through the rectum and sigmoid. Present attack began after taking a dose of oil which was without result. There was a gradual swelling of the abdomen with intermittent spasmodic pain.

Roentgen examination showed the diaphragm to be exceedingly high on both sides. On the right side it reached the fourth rib and on the left side the fifth (Fig. 15). Further study revealed the fact that there was extreme dilatation and distention of the colon, giving the typical appearance of megacolon. Where the dilated colon passed over the liver, the gas in the colon allowed the rays to over-penetrate this area, thus obliterating the usual liver shadow.

BILATERAL EVENTRATION OF THE DIAPHRAGM

Case 12. D. B., m., age 7. Referred by Dr. C. G. Kerley. Constipation since birth. Had been breast-fed for six months and then there had been great difficulty in selecting the proper food. At eight months had an operation for partial obstruction of the intestine. Had cyclic vomiting, about every forty-eight hours, at the age of three or four years. At the time of examination was passing "sand-like" material.

Physical examination showed distention of the abdomen. Liver dullness could not be obtained. The chest was somewhat deformed.

Roentgen examination showed extreme dilatation of the sigmoid, which passed beyond the midline to the right iliac crest.

There was also extreme dilatation of the splenic and hepatic flexures. The transverse colon was remarkable in the fact that it was *not* dilated. The findings were typical of megacolon of an unusual type, due to the fact that there were three dilated portions with relatively normal portions between the dilated areas. The diaphragm was remarkably high, reaching to the fourth rib on each side, indicating bilateral eventration. A conservative operation was performed by Dr. Downes in which bands of adhesions in the pelvis were divided. This allowed the colon to function in such a way that no further operative procedure has been found necessary after eight years.

BILATERAL EVENTRATION OF THE DIAPHRAGM

Case 13. L. M., m., age 7. Referred by Dr. L. Emmett Holt. History of distended abdomen since six months of age. Constipation requiring catharsis or enema to produce a movement. General condition good.

Roentgen examination showed that the diaphragm on the left side reached the fourth rib and on the right side the fifth, giving the typical appearance of bilateral eventration of the diaphragm. The stomach was ptosed, the greater curvature one-half inch below the umbilicus. The colon was greatly dilated throughout, but this was particularly marked about the hepatic and splenic flexures. The condition was typical of megacolon. In spite of the extreme dilatation of the colon its function was such that operative intervention did not appear advisable for there was remarkable freedom from auto-intoxication.

Comment. Apparently these cases become immune or "vaccinated" by reason of the constant absorption from the colon of small amounts of toxic products.

SUBPHRENIC ABSCESS

Case 14. C. H., m., age 34. Referred by the Medical Service of St. Luke's Hospital, Dr. W. A. Bastedo. Rupture of appendix five years previously. Pain in chest and abdomen for two weeks before admission and loss of weight and temperature for one week. Came to St. Luke's with a clinical diagnosis of pleurisy with effusion on the right side.

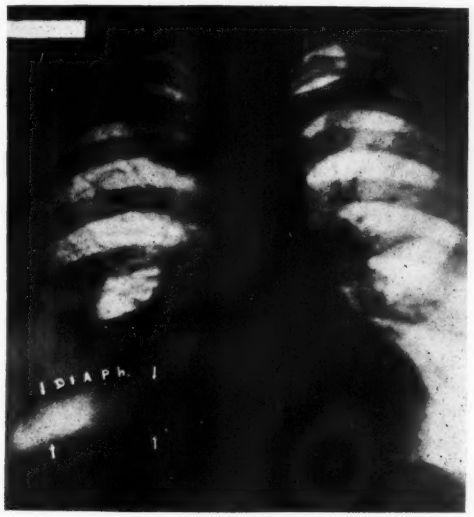

Fig. 16. CASE 14. Subphrenic abscess. Male, age 34. Air in peritoneal cavity above liver due to rupture of a duodenal ulcer. This should never be mistaken for eventration of the diaphragm.

Exploratory puncture right side: 30 cc. of fluid drawn.

Roentgen examination disclosed an unusual appearance of the right side due to the presence of gas beneath the diaphragm (Fig. 16). Above the diaphragm there was distinct evidence of exudate obscuring the upper margin of the diaphragm and extending out into the axillary region. The heart was slightly displaced to the left. Diagnosis: Subphrenic abscess; subacute pleurisy with exudate.

Operation by Dr. R. W. Bolling. Subphrenic abscess with gas. Anterior incision and drainage.

Roentgen examination three weeks after operation: The duodenum showed a lack of filling with a 24-hour retention in the stomach, suggesting the probability of a cicatrization of a duodenal ulcer which had

perforated and produced the subphrenic abscess.

CONCLUSIONS

1. Thoracic stomach is an entity of congenital origin with development of the diaphragm below it, *without structural defect.*

2. A thoracic stomach remains *at all times* above the diaphragm. In hernia of the diaphragm the stomach may be found, at times, below the diaphragm.

3. In thoracic stomach the short esophagus enters the stomach above the diaphragm. The duodenum passes through the opening in the diaphragm usually occupied by the esophagus.

4. The condition of thoracic stomach is not incompatible with longevity.

5. In eventration, the diaphragm can always be made out above the stomach, especially in lateral exposures.

DISCUSSION

DR. E. H. KESSLER (St. Louis): Dr. LeWald has shown that Nature makes mistakes in development in various parts of the body and that the diaphragm has not escaped. In the latter part of his paper he mentions that the stomach being above the diaphragm, or mostly above the diaphragm, has not at times interfered greatly with the patient's comfort or his ability to work. I would illustrate that in this way: last year at the meeting I presented a case—I have presented a series of cases, but I did not call them thoracic stomachs because I thought I could always get a view of the diaphragm and I classed them as diaphragmatic hernias, non-traumatic. I am only speaking now of non-traumatic, in which there is no known history of violence. Two of those young men came in for examination for other purposes. Both had been soldiers and had served in the trenches, one of them with the greater part of the stomach on the diaphragm, so much so that I could never locate the entrance of the esophagus into the stomach, or the bulb. The other had two-thirds of the stomach above the diaphragm with the bulb and the lower third below the diaphragm. These stomachs were permanent in that position so far as I could judge; I could not bring them down.

Then we have another class which the Doctor did not mention. However, I would not class them thoroughly as thoracic stomachs, but as hernias, and that is this: a case in which practically the entire stomach, at times, is above the diaphragm, and where, if it will fill in that position, it will stay quite a while. I have illustrations of that, of the various stages of increment. That stomach will stay above the diaphragm, practically the entire stomach. Then, by gaining the patient's confidence and having a relaxation, the contents will be seen coming below the diaphragm and filling in a normal manner with the exception of possibly one-fourth or one-fifth of the stomach which always stays up. Now palpating that again, you can push the entire contents above the diaphragm, have it lay on the diaphragm or up-side of the heart, and drop a glass or anything that will excite the patient, and hold it there again for fifteen or twenty minutes or longer before it begins to come down again. The Doctor spoke about thoracic stomach being an entity. It has remained for him to show that the entire absence of the diaphragm on that side does occur. That, I have not seen. However, we know it does occur, for the Doctor had the autopsy to show it.

Now, talking of a child: during gestation the mother was taken with whooping cough, had whooping cough the entire time, and at the time of the child's birth, this child developed whooping cough and had it about the first eight months of its life. The child developed practically in a normal manner, went to school, came in for examination for a different reason, and it was found that over one-half of the stomach was above the diaphragm, and is there to-day, I suppose. Now I class that as non-traumatic, but I have often thought it is possible that the exertion of the whooping cough in the infant, while the diaphragm

was developed in a normal manner, might have split the fibres and thrown the stomach in the way. I have enjoyed the Doctor's paper.

DR. E. H. SKINNER (Kansas City): Probably this question of hernia of the diaphragm is one that is going to come to our attention more and more because of automobile accidents, because automobile accidents usually occur with people in a sitting position, when there is more pressure exerted at the upper portion of the abdomen than the lower portion. Most of the inguinal hernias have resulted from exertions, from lifting or heavy work. You are all familiar with the fact that so many railroads have to defend suits because of hernias which have occurred in the course of the labors of their employees, and it is usually in the case of a man who is doing heavy work. Now I feel confident that we are going to have an increased number of these hernias of the diaphragm, because it is just as possible to have a muscle-splitting trauma or enlargement of one of the normal openings in the diaphragm, through the traumas incident to injuries in a sitting posture. This last case that Dr. LeWald showed is the most interesting part of it to me, and I regretted that he used the remark he did. I do not believe he really meant it himself when he said that the stomach contents were going up against gravity, because I do not believe that gravity has anything whatever to do with the movement of the gastro-intestinal contents; it is all a matter of muscular function and it does not make any difference if you loop the colon over the kitchen porch because it is going to work if it has the muscular activity necessary.

DR. S. B. CHILDS (Denver): If I may be pardoned for digressing a bit from the title of the paper, I will show two slides which were quite puzzling for a diagnosis until nearly twenty-four hours after the patient had taken the barium mixture. At this time some of the contrast meal had entered the stomach and the bulb of the duodenum was well demonstrated. Fig. 1 is an oblique view and shows the greatly dis-

Fig. 1. Oblique view. (1) Esophagus; (2) stomach; (3) bulb.

tended esophagus, the general contour of which resembles that of a stomach, and below the diaphragm is seen a small amount

Fig. 2. Postero-anterior view. (1) Esophagus; (2) stomach; (3) bulb.

of the barium in the stomach and the bulb. Fig. 2 is a postero-anterior view and shows not only the distended esophagus but also

a marked tortuosity of the same. In this view the stomach and bulb are also indicated by a small amount of the barium located therein. The distended esophagus simulates quite well the appearance of an intra-thoracic stomach, as shown in one of the cases presented by Dr. LeWald. In this connection I wish to voice the sentiment of Dr. Skinner, for I feel we are greatly indebted to Dr. LeWald for presenting this subject to us in such a comprehensive and complete manner.

Dr. LeWald (closing): The discussion brought out a couple of very interesting points. Dr. Childs' case is certainly a type of dilatation of the esophagus, usually due to cardiospasm of extreme grade, which very much simulates, as he said, a thoracic stomach. This is so true that I myself, in my enthusiasm, after reading of the Bailey case, had a case almost identical with Dr. Childs'. I had only a few moments in which to fluoroscope it and express an opinion, and I was led into the supposition that this was a thoracic stomach. It shows you how we should not be driven into a quick diagnosis in a difficult case. Often the surgeon wishes to operate on a case the next day and he requires you to make a very definite diagnosis in a few hours. In the usual case that is all right, but in an unusual case I think the roentgenologist must insist upon having enough time to study it. At any rate, on following that case through, we could demonstrate, just as Dr. Childs did, a stomach, although poorly filled, down below the diaphragm, and there was no question but that it was a dilatation of the esophagus.

Dr. Skinner's discussion is very valuable and brings out the question as to traumatism being an adequate cause for hernia of the diaphragm. I put it this way in my summary: in view of the frequency of these congenital anomalies, is it advisable to regard a particular case in which an abdominal viscus is found in the chest cavity as congenital in nature unless there is overwhelming evidence that the condition has been acquired? I spent a day on the witness stand defending this position in a case in which a child had been injured, and the Supreme Court of New York State, at last, has brought in an opinion that congenital hernia of the diaphragm does exist and that the mere fact that a person has been injured by a traumatism, and particularly, as Dr. Skinner says, if the traumatism extended to the lower part of the abdomen, as it did in this case, as evidenced by a fracture of the pelvis, is no reason for us to assume that the trauma produced the hernia of the diaphragm. One observer has gone so far as to say this, that if, at operation, the surgeon will take a section of the ring of the supposed rent of the diaphragm, and submit it to microscopical examination, then by the appearance of that section he may be able to tell whether it is due to congenital or acquired traumatic hernia; so that the distinction must be very carefully made. In this particular case I speak of, of the injury to the child, there was not shock sufficient to go with what we would suppose would result in a case of a real traumatic rupture of the diaphragm.

X-ray diagnosis of diverticula of the stomach.—The article contains a general review of the literature concerning diverticula of the stomach, together with case reports and roentgenograms of two cases diagnosed by X-ray examination.

The diagnosis of gastric diverticula has to be made by the X-ray examination, for there are no characteristic symptoms, so far as is known. In cases of traction diverticula, the symptoms, if any, are similar to those of any inflammatory condition with adhesions, and in all cases reported other lesions present have been sufficient to warrant the symptoms complained of, without consideration of the diverticulum *per se*. Therefore, without pathognomonic symptoms or signs, the X-ray picture of a sac communicating with the stomach is required in order to make a diagnosis. Even when such a condition is present, it is difficult—and at times impossible—to decide the etiology of the condition portrayed.

J. D. Camp, M.D.

Diverticula of the Stomach. E. S. Emery, Jr. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 354.

THE VALUE OF THE X-RAY IN THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE ESOPHAGUS [1]

By PORTER P. VINSON, M.D.
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RADIOLOGY occupies a position of well-deserved prominence in the diagnosis and treatment of diseases of the esophagus. In this discussion, however, I wish to present its limitations, as well as its valuable points.

Fig. 1 (A386310). Carcinoma of the esophagus with typical radiographic findings.

The most common lesion in the esophagus is cancer, and in cases of obstruction due to cancer the radiologic findings are usually quite characteristic. The moth-eaten, irregular outline of the obstruction is not seen in other esophageal lesions (Fig. 1). In many of these cases, especially in growths at the cardia, the obstruction is smooth, and not infrequently diagnosed as cardiospasm (Fig. 2). Unless the outline is irregular, the lesion should not be considered cancer. The extent of the malignant stricture usually cannot be determined by the X-ray (Fig. 3). In cases of malignancy at the introitus, examination by the X-ray may lead to confusion, because the barium mixture may overflow into the trachea and suggest the existence of an esophagotracheal fistula.

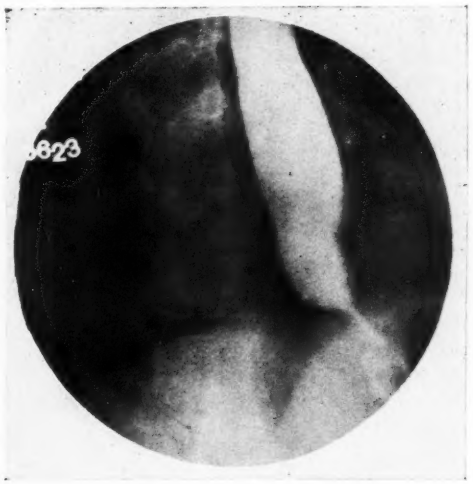

Fig. 2 (A386623). Carcinoma at the cardia with moderate dilatation of the esophagus simulating cardiospasm.

Perforation of a malignant esophageal growth with the formation of an esophagotracheal or esophagobronchial fistula is

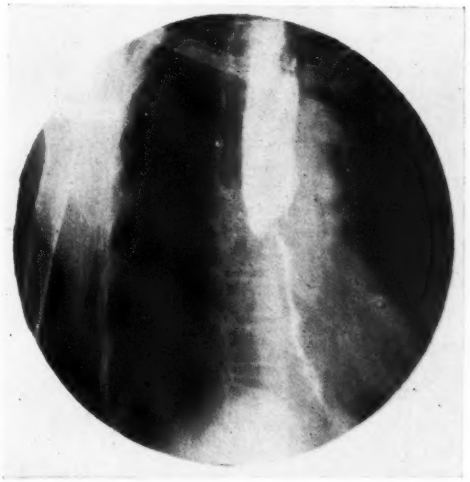

Fig. 3 (A283977). Carcinoma of the middle third of the esophagus. Note the trickling of the barium mixture from the point of obstruction to the stomach, making it impossible to determine the extent of the malignant stricture.

[1]Read before the Radiological Society of North America, December 3-7, 1923, Rochester, Minnesota.

easily demonstrated with the X-ray, and in such cases forcible dilatations of the growth should not be attempted (Fig. 4). It must be understood that, unless the malignant growth in the esophagus is sufficiently advanced to obstruct the barium meal, diagnosis by X-ray is impossible.

Fig. 4 (A322470). Esophagotracheal fistula from carcinoma of the esophagus with barium in the bronchi.

In the treatment of esophageal cancer, the X-ray is of limited value; however, it may aid in the exact introduction of radium capsules or needles. In cases of cardiospasm, the chief value of the ray is to demonstrate the amount of dilatation of the esophagus above the spasm. The degree of pressure used in stretching the cardia varies with this dilatation.

In several clinics, the dilator is introduced into the cardia guided by the fluoroscope, but if a thread is used as a guide, manipulation under the fluoroscope is not only unnecessary but distinctly disadvantageous.

In two cases seen at the Mayo Clinic, the X-ray demonstrated diverticula of the middle third of the esophagus, associated with cardiospasm (2). The differentiation of cardiospasm and diverticula of the lower end of the esophagus, congenital or acquired herniation of the stomach through the diaphragm, and diverticula of the cardia, can best be accomplished by careful fluoroscopic studies.

Fig. 5 (A118020). Typical radiographic findings of a benign esophageal stricture. Note the smooth outline of the obstruction.

In the examination of cicatricial strictures of the esophagus, if the etiology is definitely known, the X-ray is rarely used. There is usually a smooth obstruction (Fig. 5), and knowing the point of stricture before passing sounds is of no value. Benign strictures may obstruct the lumen of the esophagus sufficiently to produce considerable dysphagia, and yet not enough to give definite X-ray findings.

The fluoroscopic findings of pharyngoesophageal diverticula are quite characteristic, but a study of plates alone may lead to errors in diagnosis, as a benign or malignant stricture of the upper esophagus may present strikingly similar pictures (Fig. 6). Diverticula of the middle portion of the esophagus are rarely demonstrable unless there is an associated obstruction at the cardia. Diverticula of the lower

third of the esophagus are rare, and the diagnosis has been made when the lesion was simply a cardiospasm with an irregular dilatation of the esophagus above the point of spasm. Esophagotracheal and esophagobronchial fistulas, resulting from benign lesions, have been demonstrated occasionally. The fluoroscopic examination has also been of value in demonstrating complete congenital obstructions of the esophagus.

The negative findings from an X-ray examination are useful in the diagnosis of functional or hysterical dysphagia. There are no characteristic findings in esophageal strictures resulting from syphilitic or tuberculous ulceration. Mediastinal tumors very rarely give rise to marked dysphagia from external pressure on the esophagus. Such tumors are usually easily demonstrated by the X-ray.

Opaque foreign bodies in the esophagus are, of course, easily discovered by the aid of the X-ray, and the fluoroscope is sometimes of very great assistance in their removal. The presence of a non-opaque foreign body may also be determined by the X-ray.

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DISCUSSION

Dr. I. Seth Hirsch (New York): I would, first, like to say a word or two about the methods of examination. This is an important consideration in determining the value of the X-ray in the diagnosis of diseases of the esophagus. In order to be able to note any irregularities of the surface of the gullet, it is essential to use such a contrast mixture as is able to coat or paint the lumen of the esophagus without distending it. It is therefore necessary, in order to be able to determine the slighter changes in morphology, first, to use a small quantity of contrast mixture; secondly, it is essential that this small quantity of the mixture have the maximum opacity. To that end, many years ago, after experimenting with a great many substances, I found that a

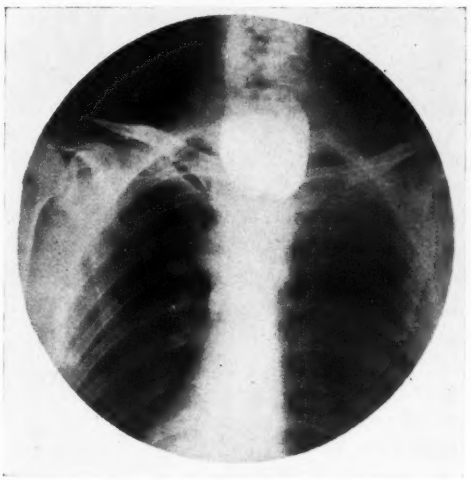

Fig. 6 (A428866). Carcinoma of the upper esophagus with dilatation above the growth simulating a pharyngo-esophageal diverticulum.

mixture consisting of barium and bismuth, without the use of water, suspending a tablespoonful of the contrast salt in a teaspoon of mucilage acacia, served the purpose. We have never in our experience had any difficulty even with the severest form of dysphagia in being able to administer enough, and half or three-quarters of a teaspoonful is sufficient, to outline the esophagus in all its parts. This mixture has sufficient consistency to produce definite waves of peristalsis when the swallowing effort is made. A too fluid mixture is squirted through the esophagus so that the peristaltic waves may not be apparent. A too solid mixture or capsule has its obvious disadvantages. By a modification of this mixture my associate, Dr. Rendich, has been able to demonstrate the rugæ of the stomach with a great deal of accuracy, and in the July, 1923, issue of the *American Journal of Roentgenology* will be found a description of this method. Now the essential method of examination of the esoph-

agus is, of course, the fluoroscopic. I think every one appreciates this and it is not necessary to dilate upon it, but there is one maneuver in fluoroscopy of very great importance, and that is the magnification of the image by the withdrawal of the screen, when at some point a break in the bismuth shadow or a deviation from the normal peristaltic wave is found. This has aided me in some instances in making a diagnosis of a small lesion, which, if it were examined with the usual position of the screen and with any other mixture, would, I am sure, have been overlooked. It is necessary in studying the esophagus to study it exactly as one would the stomach. It is not sufficient to look for a point of obstruction. One has to study the form, outline, position, tone, peristalsis, etc. The differentiation between cardiospasm and carcinoma of the cardiac end of the esophagus is not always simple or easy. Of course, the problem is simplified when there is marked dilation, and as Dr. Vinson's plates show, there is never, in any lesion of the esophagus, the extensive dilatation which is present in cardiospasm. The tone of the esophageal wall in cardiospasm is absolutely lost, while in carcinoma of the esophagus the peristaltic wave is well marked, persistent and apparent to the point of stenosis. The peristalsis in cardiospasm is of a different character from that in a normal gullet. The waves are smaller, of lesser amplitude, and are more in the nature of circular spasmodic contractions. One word in reference to the perforation of the esophagus. The entry of the esophageal content into the bronchial system, due to the perforation by tumor, is not a rare occurrence. But because of a lesion high up in the esophagus it is possible to obtain an entry of the bismuth content through the chink of the glottis directly into the bronchial tree, without actual perforation. This is due to a discoördination of the swallowing act by which there is an entry of the mixture through the larynx into the trachea. This discoördination of the swallowing act may also take place as a result of a carcinoma of the diaphragmatic end of the gullet. Some of the cases in the literature evidently reported as penetration of the esophagus with the entry of the content into the bronchus have been really due, not to perforation, but to entry in the particular way I have indicated. In reference to the treatment, one would think, judging it on the *a priori* evidence, that carcinoma of the esophagus ought to be a condition amenable to treatment. It is a localized lesion of slow growth, which does not metastasize, but the difficulty appears to be to get the radiation to the point of tumor formation. Until the beginning of this year I placed the radium in a capsule made of rubber except the top, which was of metal, and attached to a silk string. This was inserted into the gullet by means of the usual stilet. That did not work out very well because there was no intimate contact between the radium and the growth, so that for the last year I have adopted Dr. Mills' method of a more rigid support for the capsule, applying it to the mass and then checking it up fluoroscopically to see if the capsule was in place. There is just one precaution in the application of radium: the first application must be a mild one, because, if the patient has had only a moderate degree of dysphagia, the resulting reaction pretty promptly closes up the chink left and there may be absolute dysphagia. Then X-ray may be administered through both portals posteriorly at an angle of 120 degrees. The results have by no means been gratifying. In some of the cases there may be an amelioration of the symptoms for only a short period of time; in others they apparently go on without any improvement. These patients are, as a rule, in poor condition from under-nourishment when they come for treatment, and since, during the treatment and after it, the reparative forces must be kept up by proper nourishment, it would appear that if an opening were made in the stomach and the patient properly fed, and then the radium applied intimately, better results might be attained than we have been getting.

DR. L. T. LEWALD (New York): In congenital stenosis of the esophagus in which the opening into the trachea or bronchus is present, and where attempts to save the child have been made by operation, gastrostomy and jejunostomy have failed. Recently a case at the New York Lying-In Hospital was very boldly attacked by Dr. L. A. Wing, who went into the left chest posteriorly and succeeded without much difficulty, he said, in cutting the attachment to the respiratory tract and uniting the two pieces of the esophagus. He got the case late and it did not recover, but survived the operation a sufficient length of time to justify the opinion that this procedure may in future possibly succeed. The condition should be suspected when, a few hours after birth, inability to swallow saliva causes a drooling from the mouth, and should call for an X-ray examination.

DR. VINSON (closing): There are two or three points I want to discuss. First, the amount of the dilatation seen in cardiospasm. Cardiospasm is the only thing that will cause a wide dilatation of the esophagus, but there may be a moderate dilatation in cancer as well as in the average case of cardiospasm. Dr. Hirsch stated that the absence of peristaltic waves is characteristic of spasm. This is true, but you will frequently see definite peristalsis in a moderately dilated esophagus; rarely in an esophagus with wide dilatation. The radium and X-ray treatment in esophageal cancer of course has been most disappointing. It seems to make no difference whether the radium is directly in place or how much X-ray is given, the patient will gradually die. We have secured the greatest amount of palliation from dilating these malignant strictures. Life has been prolonged in several cases for eighteen months, and one patient lived in perfect comfort for three years after a single dilatation. When he came back after two and a half years, the X-ray revealed metastasis throughout both lungs. The question of the operability of complete congenital strictures is an interesting one. Several operations have been devised, but all have been failures. The condition is not recognized usually for four or five days, and then the patient does not live ordinarily more than eight or ten days, so that the patient is a poor subject to start with, and the operation, if one is ever successfully accomplished, is simply a heroic last-straw effort.

Roentgenologic study of the sternum.—The author believes that the roentgenologic study of the sternum has been more or less neglected and that it should be investigated routinely, especially when there is the slightest suspicion or possibility of its being diseased. Metastatic carcinoma of the sternum secondary to carcinoma of the breast is not uncommon, and also occurs secondary to mediastinal carcinoma. It resembles carcinoma of bone elsewhere. Tuberculosis of the sternum may occur from direct extension of tuberculosis in adjacent tissues. Pressure necrosis may result from a mediastinal tumor, especially when such a tumor is benign or an aneurysm. Necrosis from pressure is indicated by homogeneous decalcification or thinning of bone with no evidence of invasion, and is localized to the pressure area of the underlying tumor.

In making roentgenograms the right and left oblique positions are used, preceded by a preliminary study with the roentgenoscope, so as to direct the heart, aorta and spine shadows away from the sternum. The lateral position is the most important. The patient should stand, if possible, and force back the shoulders so as to project the sternum as far forward as possible. The top of the film is placed on a level with the upper border of the clavicles. The exposure factors are 30 ma., 4—4½ spark gap, 8—12 sec., 40 inches, double screens and superspeed films. A small diaphragm is used.

J. D. CAMP, M.D.

The Study of the Sternum by the Roentgen Rays. G. E. Pfahler. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 311.

THE INTERPRETATION OF EARLY FETAL ROENTGENOGRAMS [1]

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IN THIS communication we wish to discuss the interpretation of early fetal roentgenograms exclusive of those after pneumoperitoneum. In an article published in the *Journal of the American Medical Association*, July 7, 1923, we considered the importance of the roentgenogram showing the fetal skeleton as a positive sign of pregnancy. In the former we primarily considered the fetus from mid-pregnancy to term, while it is our desire at this time to emphasize the possibility of depicting the fetus as early as possible and to describe the findings thus obtained.

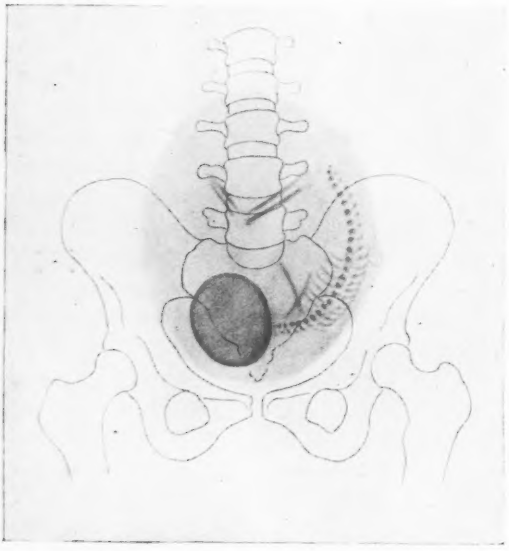

Fig. 1. Hydramnios, five and a half months' (23-24 weeks) pregnancy. Prone view.

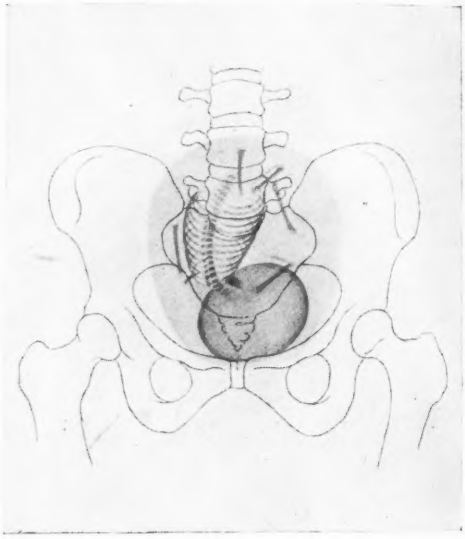

Fig. 2. Five and a half months' (23-24 weeks) pregnancy.

The problem of producing a satisfactory film in the early period, one that has a real interpretive value from a roentgenographic as well as a diagnostic standpoint, is a vastly different one than at a later period of fetal development. It is our aim to show some definite evidence of fetal bony structure at the earliest possible moment, in order to make a positive diagnosis, and we are not especially concerned at this time with the position of the fetus. Quoting from our previous paper we regard the "*roentgenogram of the fetal skeleton as the earliest demonstrable positive sign of pregnancy.*"

It has been stated by others that the fetal skeleton can regularly and constantly be depicted on films at three, three and one-half, or four months. As a result of considerable experience, and some experimentation in this period, we are compelled to take issue with this view. It has been in exceptional instances only that we have been able to visualize the fetal skeleton prior to mid-term. Even when a satisfactory film has been secured, one from which positive findings can be obtained, the entire skeletal structure usually cannot be clearly

[1] From the Adolf Stein Memorial for Research in Roentgenology. This work was supported by a grant from the Otto Baer Fund for Clinical Research. Paper read before Radiological Society of North America at Rochester, Minnesota, December, 1923.

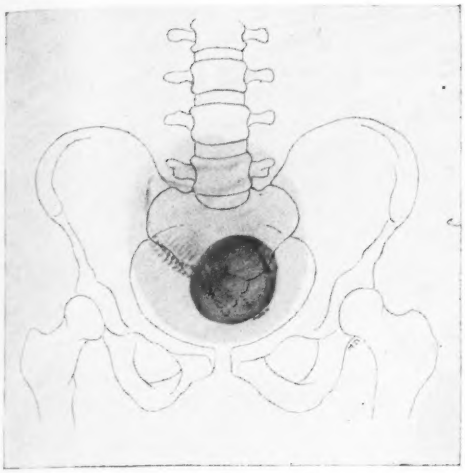

Fig. 3. Twenty-two weeks' pregnancy, arm extended over head. Dorsal view.

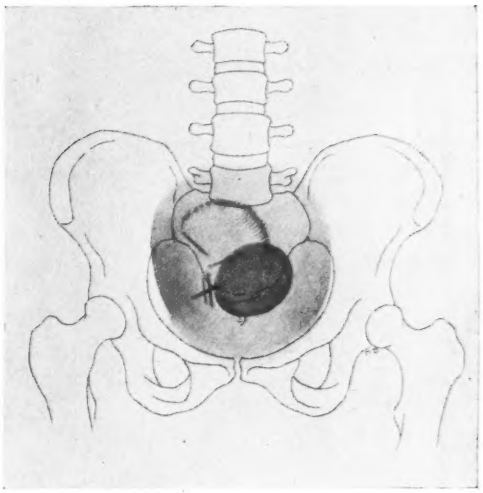

Fig. 5. Twenty weeks' pregnancy. Prone view.

outlined. Only an extremity, a few vertebræ, the head or a part thereof may appear. When the head can be seen it is the occipital bone which is usually observed, and if other cranial bones are also visible, the occiput is always densest.

When the fetus happens to lie transversely in the uterine cavity with its back presenting, almost the entire fetal skeleton may be observed on the film. The tilt of the pelvis, the relation of the sacrum to the skeletal shadows, gas and intestinal contents, pelvic contents, all or singly, may offer sufficient resistance to the passage of the rays through the pelvis, so that the resulting conglomeration of shadows wipes out the fetal skeletal shadows on the films. Adequate preparation of the patient to minimize intestinal contents is highly desir-

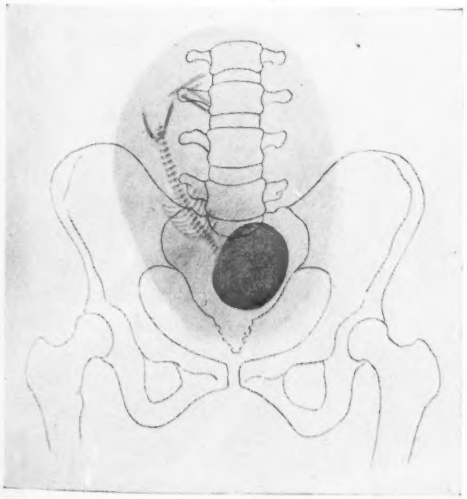

Fig. 4. Twenty-five weeks' pregnancy. Fetus evidently considerably less developed than many at 20 to 24 weeks. (Full-term fetus delivered 15 weeks after date of roentgenogram.) Prone view.

Fig. 6. Five months' (20 weeks) macerated fetus. Collapse of fetal body. Note absence of overriding and asymmetry of skull bones. Prone view.

able, but frequently is impossible to control.

The importance of the position of the patient can again well be emphasized at this time. The uterus, before mid-term, does not rise very high into the abdomen. If the roentgenogram is made in a straight antero-posterior or postero-anterior position, then the fundus which lies below the level of the iliac crests is covered by the shadow of the sacrum with its dense promontory and the fifth lumbar vertebra. The dorsal posture, with an increased lordosis, produced by placing sand bags under the lumbar spine, has proven to be the most satisfactory to us for casting unobstructed fetal shadows on the film. The central ray is then directed through the pelvis in the axis of the superior strait, and when the exposure is made the entire true pelvis can be seen from below upwards without any interference or overlapping of spinal, sacral, or pubic shadows. If the patient has been well prepared and the fetus is in a favorable location, then fetal structures may be shown. The prone posture, except with the patient hanging head downward so that the reverse of the technic just described can be obtained, is not so satisfactory. Always avoid superimposing the sacral shadow over that of the uterus, as in this event the uterine outline, as well as fetal structures, may be obliterated.

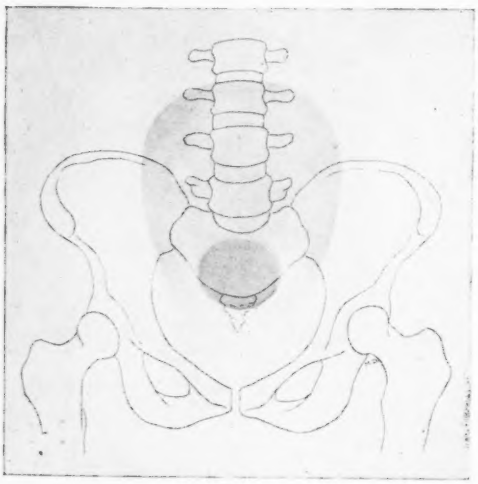

Fig. 7. Twenty weeks' pregnancy, only head and uterine outline visible. Dorsal view, with exaggerated lordosis.

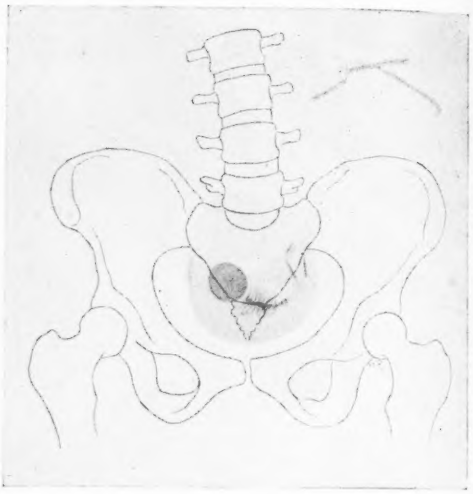

Fig. 8. Seventeen weeks' pregnancy. Prone view.

It is not only the maternal osseous structures, but the soft tissues as well, that make this work difficult. With an increase in the anterior-posterior diameter of the pelvis there is more difficulty in obtaining a satisfactory exposure. Extreme obesity usually offers a decided obstacle. It seems hardly necessary to add that the ingestion of X-ray opaque meals or opaque medication is contra-indicated, although very early in our work a probable diagnosis of pregnancy was made because a smooth, centrally placed, globular mass, outlined by the barium-filled ileum, extended out of the pelvis. In this case the roentgen findings explained a rather atypical history, and the subsequent course of events proved the correctness of the roentgen deductions.

Scattered radiation from the maternal structures, the liquor amnii, increased amount of blood to the uterus, overlying pelvic structures, intestinal contents, the relatively poor lime content of the fetal bones, all combine to increase the difficulties of projecting fetal shadows. The variable distance of the fetus from the film as

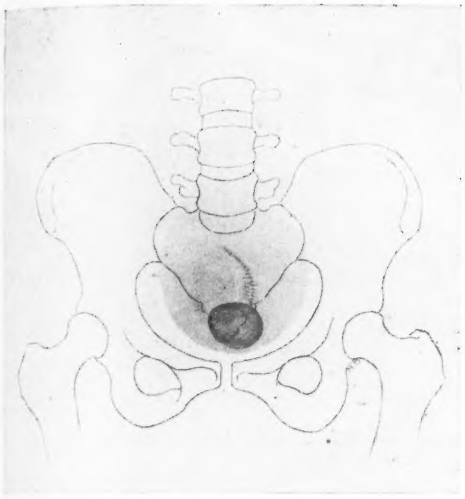

Fig. 9. Sixteen weeks' pregnancy. Prone view.

it lies in or above the pelvis may produce a distortion of such magnitude as to obliterate any shadow. Should the head be nearer the film, it may be outlined. As stated above, many early roentgenograms show only a portion of the head, a few vertebræ, a long bone or two, these latter occasionally showing only in cross-section. At best, the fetal structures usually showing at three to four months are often exceedingly difficult to recognize. It has been

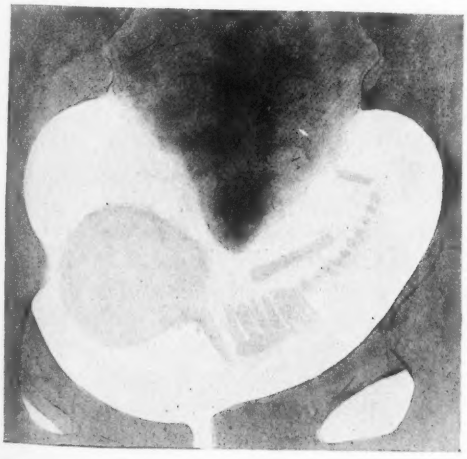

Fig. 10. Sixteen weeks' pregnancy, macerated fetus, only head visible—asymmetric but no visible overriding of skull bones.

reported that the fetus can regularly be shown at from ten to twelve weeks. We are unable to confirm this, using every conceivable technic, including pneumoperitoneum, multiple exposures, and double screen films, with and without the Bucky diaphragm. The youngest fetus we have been able to demonstrate has been estimated to be about thirteen weeks.

We have also attempted to estimate the age of the fetus from the size of the fetal

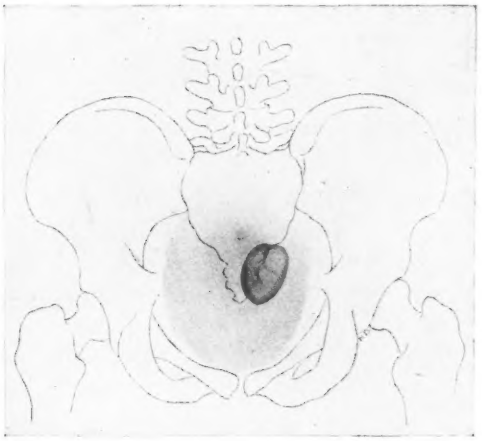

Fig. 11. Thirteen weeks' pregnancy, fetus transverse. Dorsal view.

shadow on the film, and conclude that only a very rough estimate can be made. The size of the projected shadow may be misleading, for the reasons mentioned above. Furthermore, since there is a wide variation in the size and weight of the fetus on its expulsion from the uterus at full term, is it not reasonable to expect to find more or less variation in size at mid-term or at any other period? Our observations upon the early fetus affirm this view.

In order to obtain some idea as to the discrepancy in the actual size of the fetus *in utero* and its projected shadow, we made a series of roentgenograms of feti before and after abortion, the latter under the following conditions: (1) Fetus lying directly upon the cassette; (2) with 3 inches of paraffin between the fetus and the cassette; (3) with 3 inches of paraffin above and below the fetus; (4) with 6 inches of paraffin

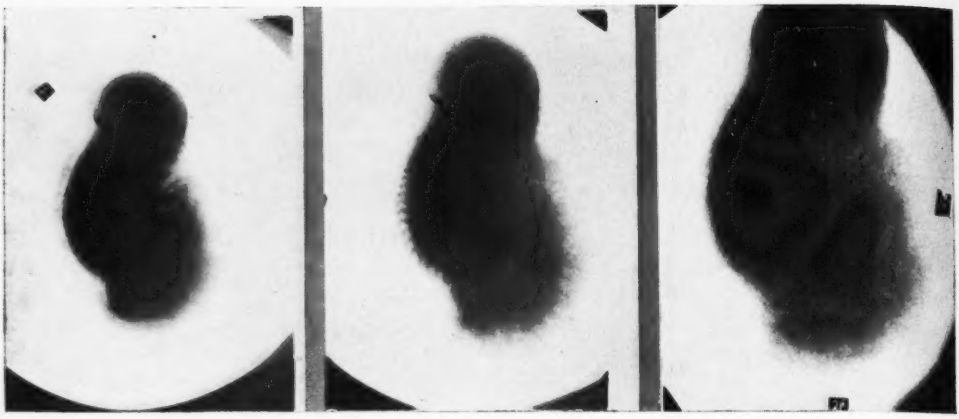

Fig. 12. Twenty weeks' fetus in amniotic sac, placenta attached. *A*, Fetus directly on film; *B*, Three inches of paraffin between fetus and film; *C*, Six inches of paraffin between fetus and film.

above and below the fetus. This gave us some idea of comparison, not only disclosing a very marked increase in the projected size as compared with the actual fetal size, but also demonstrated a tremendous loss of detail of fetal parts that became progressively worse with an increase of the distance of the fetus from the film.

Before closing, it might be well to call attention to the significance of roentgenograms of the fetus from a medico-legal standpoint. A letter from the Paris correspondent of the *Journal of the American Medical Association*, dated November 2, 1923, contains an exceedingly interesting report of a court case in which a decision was rendered against a certain Dr. Vallet, of Vernon, by the Court of Appeals of Rouen, France, for failure to avail himself of roentgen-ray facilities before operating upon a woman for fibroma when in reality she was pregnant. The decision was thus expressed:

"It is justifiable to consider whether or not Dr. Vallet, in view of the present status of roentgenology, was guilty of neglect in that he did not take advantage of the diagnostic help that roentgenology affords in doubtful cases. Although Prof. J. L. Faure testified before the court that the use of this method of exploration under the existing conditions seemed to him debatable, it is impossible to deny that roentgenology is a means of investigation that is becoming more and more common. From reliable authority, notably, Professor Potocki, Drs. Delherm and Laquerriere, and other well-qualified roentgenologists, it appears that, in the matter of disclosing the fetus *in utero*, while it is true that roentgenography is not applicable during the first months of pregnancy, it does furnish a more or less distinct picture of the fetus from the fifth month on, and especially during the last two months."

In conclusion, we feel that there are great possibilities for further development and refinement of technic of roentgenography in pregnancy, and we urge upon the members of this Society to help establish the necessary standards to place this branch upon a firm basis.[2]

DISCUSSION[3]

DR. R. S. CRON (Milwaukee): While associated with the department of obstetrics and gynecology at the University of Michigan, I remember very well the late Dr. Van Zwaluwenburg saying to me, "Cron, do you know that roentgenology is not used enough in obstetrics and gynecology?" Shortly after that Peterson and Van Zwaluwenburg published many papers on the diagnosis of obstetrical and gynecological

[2]We wish to express our sincere appreciation to our colleagues in both departments for their cooperation and encouragement, and to Mr. Stegall and Miss Dixon for their conscientious efforts.

[3]The paper on "Obstetric Roentgenology," by Dr. A. W. N. Dorland, was published in "Radiology," July, 1924, p. 10.

conditions by means of the X-ray after the pelvis had been filled with carbon dioxide gas. That work as well as that of the essayists is proof that roentgenology, in the future, will be used more and more to diagnose obstetrical and gynecological conditions.

It has recently been my experience to determine by roentgenograms the condition of the upper extremities of a seven months' intra-uterine pregnancy. The expectant mother wished to know whether her child would have a mal-developed left arm like her husband's. We were able to satisfy her anxiety by demonstrating normal and full development of both upper extremities.

In our hands the use of the X-ray for pelvimetry has not proven satisfactory. The technic of Newell and Chamberlain of San Francisco has seemed too complicated for practical purposes. However, we have been able to get some idea of the relative size of the presenting part and pelvis by taking stereoscopic plates while the patient was lying in the lateral position.

The sign of fetal death, namely, overlapping of the cranial bones, referred to by Dr. Dorland, was also recognized by Dr. Alfred B. Spaulding of San Francisco at approximately the same time that Horner demonstrated it. Accordingly, it seems to me that due credit should be given him.

One of the earliest fetal skeletons that I have ever seen demonstrated by roentgenography was that more or less accidentally obtained by Stein and Arens after injecting the pelvis with carbon dioxide gas and taking films of the pregnant uterus while the patient was in the modified knee-chest position. As I recollect, the reason the fetal skeleton showed was because there was insufficient inclination of the patient, resulting in the rays passing through the thinnest part or short axis instead of the thick or long axis of the uterus. At Ann Arbor it is the practice now to obtain roentgenograms of early pregnancy with the patient in the prone position rather than the dorsal. It is the opinion of both Doctors Hickey and Peterson that, with the exception of women with a heavy panniculus, satisfactory skiagraphs of fetal skeletons can be shown from the fourth month of pregnancy on.

To me, the preparation of patients for this kind of work is very important. The gastro-intestinal tract must be as empty as possible. This is accomplished by purgation and enemas. The patient must urinate before coming to the X-ray room.

I have a few slides illustrating the technic used in taking roentgenograms of early pregnancy. There are also a few pictures of early pregnancy with and without the injection of carbon dioxide gas into the pelvic cavity. The first slides show the table with the patient in position for the making of pneumoperitoneal roentgenograms. The diagram illustrates the rays from the Cooldige tube passing through the pelvic structures and projected onto the film below. The first slide showing pelvic organs is that of a normal pelvis. One can distinctly make out the bony landmarks, bladder anterior, uterus in mid-position hanging freely in the pelvis with a dense area in the center, appropriately termed by Dr. Van Zwaluwenburg "the isthmus of the uterus." Both ovaries can be seen. The oviducts when normal generally do not cast a shadow.

The next few slides are of early pregnancy. These were all diagnosed by the radiologist without the aid of the obstetrician. In every case the diagnosis was proven by the patient giving birth to a fetus at the proper time. The films show a uniformly enlarged homogeneous uterus with proportionate widening of the isthmus. These women when irradiated had skipped one or two menstrual periods.

The differentiation between pregnancy and fibromyomatous conditions of the uterus is well illustrated in two slides, showing unusual density, the irregular outline and absence of widening of the isthmus of the uterus.

The films from which the remaining slides were made are roentgenograms of fetal skeletons taken without the aid of pneumoperitoneum. The duration of these

pregnancies varies from five months in the first slide shown to three and three-fourths months in the last. In the first slide one can make out skull, long bones and vertebræ. In the others only long bones and vertebræ can be seen. Following each original film I will show for demonstration purposes retouched films obtained by placing the original film between two exposed but undeveloped plates and then outlining the fetal bones on the upper one. The last slide is especially interesting because the patient would not admit an exposure to pregnancy until after the fetal skeleton had been demonstrated to her.

It has been a great pleasure to have had an opportunity to discuss these papers and to have demonstrated some of the work that is being done at the University Hospital, Ann Arbor, Michigan.

Dr. R. A. Arens (Chicago): I was very much interested in one point in Dr. Dorland's paper regarding the possibility of injuring the fetus *in utero* by exposure during the taking of the roentgenograms. I would like to give the result of our experience in this regard. We have irradiated over 500 cases in which anywhere from two to possibly eight and in some cases even ten films have been taken, not including cases in which a pneumoperitoneum was done, and we have yet to find out where we have injured a fetus in any one case. All cases, as far as we were able to ascertain, were delivered in normal manner; the fetus was normal, no abnormality was discovered. I would like to ask Dr. Cron whether or not in their experience in Ann Arbor they had made similar observations or whether they have had any injury to the fetus in this work, and also would like to ask anyone else present if they can corroborate the work of Drs. Bailey and Baggs.

Dr. J. F. Herrick (Ottumwa, Iowa): In answer to the last speaker's question and as a warning, the following may be reported: A certain woman went to a gynecologist to learn if she were pregnant. He told her she was probably about two or three months pregnant. She said she wanted something done, as she did not want children. The doctor refused to give her any assistance. She went to a roentgenologist and told him she had a fibroid tumor, that it had been so diagnosed by different doctors, and that she wanted to take X-ray treatments for it. The doctor very obligingly—and evidently without much investigation—gave her a course of treatments. She did not abort, but, rather, in due time gave birth to a monstrosity. It had some of the characteristics of the cretin, and of course caused considerable gossip in the vicinity. In this age of diffused knowledge almost everyone has some knowledge of the effects of the X-ray. It behooves the radiologist to be his own diagnostician unless he is in direct contact with some physician who is competent as well as honest.

Dr. R. R. Newell (San Francisco): I have been very much interested in these two papers, also in the discussion of Dr. Cron, which was almost a paper in itself. In regard to the injury of the fetus by taking X-ray pictures of a pregnant mother: One must expect effects on a fetus from the X-ray, the same as he would on an individual from the X-ray, and perhaps, if sufficient dosage were given to injure the fetal thyroid, one might expect a cretin.

In fruit flies they succeeded in changing the heredity by X-rays, given apparently during the maturation division, which produced changes in the disjunction of the chromosomes. Here is, possibly, a source for monstrosities, but I think we are none of us talking about X-rays given during maturation of the ovum,—we are all talking about X-rays given during the development of the fetus. I was impressed by this case of injury to the fetus by treatment for fibroids. I remember one other case reported in the literature of a monstrosity being delivered after treatment for fibroids —but those were treatments. Dr. Dorland's collection of pelves and monstrosities is a very remarkable one indeed,—I have never

seen anything quite so extensive. His pictures were certainly excellent. These monstrosities fascinate us, partly through their rarity, but I think they also depress us very much. They are horrible things.

In regard to pelvimetry, I was not at all astonished to hear Dr. Cron say that he thought our method was too complicated for use. It does seem complicated. Yet while it is somewhat more complicated than eye localization, it is not very much more complicated than a blood count. We reported it three years ago, and we are still using it more or less continuously at Stanford. I will say that the cases are mostly limited to clinic cases. Apparently most obstetricians do not feel that they should put a patient to the expense of an X-ray measurement of the pelvis, most cases not being sufficiently doubtful to require that, being fairly clear from outside measurements. We are called in to settle the question of the size of the pelvic outlet repeatedly. I think we have found more discrepancy between measurements by X-ray and by external pelvimetry of the outlet than of the other measurements. So far we have not been caught making mistakes, although we have frequently been at variance with the obstetricians to the extent of as much as 3 cm. in the bisischeal diameter and have made the decision between letting patients go to labor or delivering them by Cesarean section. We have been asked to do pelvimetry on several primiparæ who had been long in labor and had not come through, in whom the external measurements were apparently normal. In all cases we have found normal sized pelves. In about half of them by the time we could get the pelvis measured up the woman had had her baby. It affords a certain assurance to an obstetrician in a case of prolonged labor.

In regard to fetal death, I would call attention to the reason for our being able to diagnose fetal death. It is due to the desiccation of the fetus after maceration has begun. We have twice failed to diagnose fetal death in the case of a macerated fetus. In both cases, I was able to examine the fetus after delivery and pick up the loose scalp and estimate the amount of shrinkage of the head which we had failed to see. In both those cases there was about 1½ cm. of loose scalp. Apparently a shrinkage of 1½ cm. was not sufficient to produce an overlapping of the bones of which we could be sure. In regard to the extra density of the bones in the case of fetal death, I wonder if it is not a case of the smaller size of the head. The head has once been large but has become small. You have two things: the bones of the previous density now appear in greater contrast because of a smaller abdomen and also relatively denser because you expect bones of that size of head not to be so dense.

Dr. H. J. Ullmann (Santa Barbara): I wish to give you some data so that you may do your own figuring in regard to the amount of radiation affecting growing animals. One one-hundred-and-eightieth of the so-called standard dose of copper filtered radiation for malignancy applied, on the average, four times a week makes a marked difference in the growth of guinea pigs. If begun when the animal is four days old the radiated pig grows much faster than the unradiated. Now figure out your own dosage and how often you wish to give it.

EXPERIMENTAL WORK BEARING UPON THE STANDARDIZATION OF THE ABSORPTIVE POWERS OF THE X-RAYS BY SALTS OF THE VARIOUS METALS[1]

By LEON J. MENVILLE, M.D., New Orleans
Radiological Division, Department of Medicine, Tulane University of Louisiana

DURING the process of certain experimental work now under way, it was noted that little information concerning the density of the shadows produced by the various metallic salts was available in the literature. Various workers in the study of the visualization of certain of the tracts of the human body, such as the alimentary and urinary tracts, have brought forward different selected substances, but little is mentioned of the manner in which these substances were chosen, and no evidence of an effort at standardization can be found. While it is true that certain very important and fundamental principles concerning absorbability based upon atomic number formulæ have been determined recently by Hull (1) and by Richtmyer (2), nevertheless it occurred to the writer that definite efforts directed towards the tabulation and formation of a shadow scale for as many of the metallic salts as possible, would form a practical working basis for problems of investigation wherein this important factor is brought into consideration.

In experimentation *in vivo*, two other important factors must be considered, namely, the solubility and the toxicity of the different substances. In conjunction, therefore, with the tests of absorption capacity or shadowing of these various metallic salts, the data appertaining to the solubility and toxicity of the different substances have been gathered as far as was practicable from the literature.

It may be well to describe, first, the manner in which the absorption can be calculated, as shown by Hull, on the law governing absorption: "That if the cube of the atomic number of the absorbing substances be multiplied by the cube of the wave length and this product by the number .00658, then to this product is added the number .14 and this sum multiplied by the density of the absorbing substance in grams per cubic centimeter, the final product will be the coefficient of absorption; that is, a number which will define the rate of decrease in intensity of X-rays per unit thickness of material traversed, the unit in this case being one centimeter."

We know that every substance absorbs a certain quantity of X-rays passing through it, thereby casting a shadow. Some substances are more absorbent than others, and will cast a much darker shadow. This absorption or shadowing is about in proportion to the cube of the atomic number of the substance multiplied by its density.

As it is appreciated that in certain phases of experimentation in radiology, a tabulation of the approximate absorbability of the elements will be of value, it seems justifiable to set forth in table form the comparisons as estimated by the method of cubing the atomic number, multiplied by the density. The absorbability of many of these elements in compound has been verified by actual experimentation, as demonstrated in the figures later to be explained. Table I, therefore, represents a summary of comparisons which it is hoped may be found of service to those dealing with such phases of experimental radiology. As the resulting figures are very large, for sake of brevity, beryllium has been chosen a unit of 1, on account of its low absorbability to X-rays, in this manner reducing the large column of figures to smaller ones, which will be found more convenient in calculating the approximate absorbability of the various

[1]Read before the Radiological Society of North America, December, 1921.

metallic salts. Table I presents these results computed in the above manner.

TABLE I

Elements	Symbol	Atomic No.	Density	Absorption	Absorption to Beryllium
Uranium	U	92	18.7	14561465.6	117887.512
Iridium	Ir	77	22.5	10271992.5	83160.561
Platinum	Pt	78	21.3	10202868.0	82600.939
Osmium	Os	76	22.5	9876960.0	79962.435
Gold	Au	79	19.3	9525513.4	77117.175
Thorium	Th	90	13.3	8237700.0	66691.224
Tungsten	W	74	19.0	7699256.0	62332.059
Mercury	Hg	80	13.5	6912000.0	55958.549
Tantalum	Ta	73	16.6	6457682.2	52280.458
Thallium	Tl	81	12.0	6377292.0	51629.638
Bismuth	Bi	83	10.0	5717870.0	46291.045
Lead	Pb	82	11.3	4377258.4	35437.648
Samarium	Sa	62	9.0	2144952.0	17365.220
Neodymium	Nd	60	7.0	1512000.0	12240.932
Erbium	Er	68	4.8	1509273.6	12218.860
Cerium	Ce	58	7.0	1365784.0	11057.189
Praseodymium	Pr	59	6.5	1334963.5	10807.670
Rhodium	Rh	45	12.5	1139062.5	9221.684
Lanthanium	La	57	6.1	1129677.3	9145.541
Palladium	Pd	46	11.4	1109630.4	8983.406
Silver	Ag	47	10.5	1090141.5	8825.627
Ruthenium	Ru	44	12.3	1047763.2	8482.539
Cadmium	Cd	48	9.0	995328.0	8058.031
Xenon	Xe	54	6.0	944784.0	7648.834
Antimony	Sb	51	7.0	928557.0	7517.462
Tin	Sn	50	7.2	900000.0	7286.269
Niobium	Nb	41	12.8	882188.8	7142.071
Telerium	Te	52	6.2	871769.6	7057.720
Indium	In	49	7.12	837660.8	6781.580
Iodine	I	53	5.0	744385.0	6026.432
Molybdeum	Mo	42	10.0	740880.0	5998.057
Barium	Ba	56	4.0	702464.0	5687.046
Caesium	Ce	55	2.0	332750.0	2693.814
Zirconium	Zr	40	4.0	256000.0	2072.538
Yttrium	Yt	39	4.0	237276.0	1920.948
Copper	Cu	29	8.93	217793.7	1763.226
Arsenic	As	33	6.0	215622.0	1745.644
Nickel	Ni	28	8.9	195372.8	1581.709
Zinc	Zn	30	7.0	189000.0	1522.02
Krypton	Kr	36	4.0	186624.0	1510.880
Germanium	Ge	32	5.5	180224.0	1459.067
Gallium	Ga	31	6.0	178746.0	1447.101
Selenium	Se	34	4.5	176868.0	1431.897
Cobalt	Co	27	8.6	169273.8	1370.41
Strontium	Sr	38	2.54	139374.8	1128.358
Bromine	Br	35	3.0	128625.0	1041.329
Titanium	Ti	22	11.9	126711.2	1025.835
Manganese	Mn	25	7.39	115468.7	934.810
Chromium	Cr	24	6.5	89856.0	727.411
Iron	Fe	26	4.95	87001.2	704.349
Rubidium	Rb	37	1.5	75979.5	615.118
Vanadium	V	23	5.5	66918.5	541.762
Potassium	K	19	2.2	15089.8	122.164
Calcium	Ca	20	1.87	14960.0	121.114
Argon	A	18	1.78	10380.9	84.042
Phosphorus	P	15	2.2	8428.7	68.636
Chlorine	Cl	17	1.55	7615.1	61.651
Silicon	Si	14	2.3	6311.2	51.904
Aluminum	Al	13	2.7	5931.9	48.027
Magnesium	Mg	12	1.74	3006.7	24.341
Sodium	Na	11	.971	1292.4	10.463
Fluorine	Fl	9	1.69	1232.0	9.974
Neon	Ne	10	.900	900.0	7.286
Oxygen	O	8	1.4	716.8	5.803
Carbon	C	6	2.0	422.0	3.416
Nitrogen	N	7	1.2	411.6	3.332
Boron	B	5	2.5	312.5	2.53
Beryllium	Be	4	1.93	123.5	1.00
Lithium	Li	3	.534	14.418	.11672
Hellium	He	2	.178	1.42	.01152
Hydrogen	H	1	.089	.089	.00072

SOLUBLE METALLIC SALTS IN SOLUTION

In performing the experiments with these substances, wherever possible the chloride of the various metallic salts was chosen, as the chlorides are easily soluble and more generally procurable (3). In this manner the chloride assures more uniform results in the shadow cast by the various salts. In some instances, the bromides and nitrates were of necessity employed.

In order that the method employed in arriving at the tabulation and figure demonstrations may be appreciated, it is deemed advisable to explain the technic by which the results were obtained. A shadow scale (Fig. 1) was made of tinfoil .0005 inch thick, beginning with No. 1 on the scale. No. 2 on the scale consists of two thicknesses, of .0005 inch each, and the series continues in this manner up to No. 20, inclusive. For gradation above this, it was found necessary to employ greater numbers of tin sheet foil in the scale, inasmuch as few of the metallic salts in solution of high absorbability rate cast very dense shadows, and it would have been necessary to extend the scale to such a length as to prevent its being skiagraphed upon the same film with the capsules containing the salts in solution. For this reason, therefore, the following numbers are given, containing the enumerated thicknesses: No. 21, consisting of 25 pieces of tinfoil, each .0005 inch thick; No. 22, of 30 pieces; No. 23, of 35 pieces; No. 24, of 40 pieces; No. 25, of 50 pieces; No. 26, of 60 pieces; No. 27, of 120 pieces.

The skiagraphs of the various metallic salts in solution were all taken under the same conditions, using the same milliamperage (35); voltage 5½ inches back up; target tube distance, 30 inches; time, 6 seconds. The scale was skiagraphed upon

the same film as the salts in solution, thereby receiving the same exposure and development. A kilovolt meter, using as a control actual measurement between spark gap points, was employed to ascertain the voltage used. While a sphere gap was not used, it can be appreciated that the ratio of shadow gradation would, for all practical purposes, remain the same.

Gelatine capsules No. 10 were used as containers, and these were inserted in a cardboard frame. An empty gelatine capsule was skiagraphed under the same conditions as those containing the solutions, and it was found that the empty capsule cast a shadow comparing with No. 1 on the scale, making it an ideal container.

The results obtained by employing this method, and the actual salts in solution tested, are best demonstrated by referring to Table III and Fig. 2.

The comparison of the shadows cast by the various compounds in solution with the scale was made from the film itself, and not from the prints, as the latter are not accurate and are misleading. The film was cut in sections so as to have a close approximation of the skiagraphed solutions to the scale for accurate comparison. Comparison was made with an X-ray colorimeter devised by the author.

Certain compounds in solution (Table III and Fig. 2) showed a discrepancy when compared with the reference table and scale, casting shadows of lessened density, e. g.,

Erbium Nitrate
Lanthanium Chloride
Samarium Chloride
Copper Chloride
Nickel Chloride
Praseodymium Nitrate
Zirconium Nitrate
Chromium Chloride

The discrepancy for the above compounds was not great, except in the cases of chromium chloride and praseodynium nitrate. On the other hand, we find that sodium bromide solution, having a comparatively low absorbability rate (that is, the

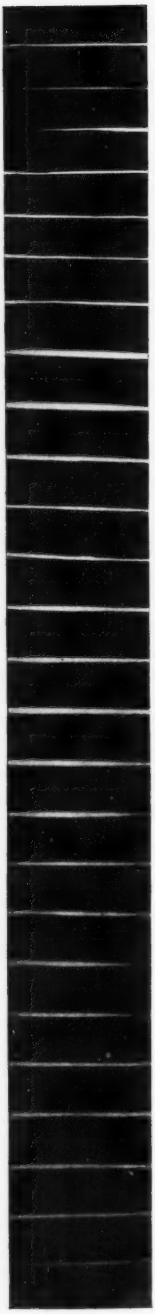

Fig. 1. Representing print of metallic scale as described in text. By reproducing from the original film much is added, making it not accurate, and it is only submitted to show how the scale was set up.

shadow cast by sodium bromide in solution should not be a very dense one), in reality casts a rather dense shadow comparing with No. 21 on the scale. Zinc chloride behaves similarly, though not to such a great extent.

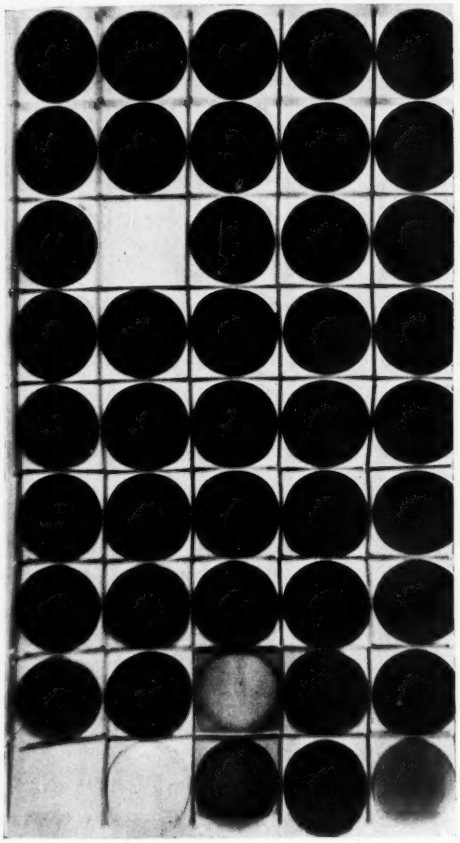

Fig. 2. Representing the various compounds in solution; for identification refer to Table III. It is to be noted that the print is not a true representation of the original film, and no comparisons are made from it.

To ascertain if the discrepancy would be modified by varying the spark gap, several tests were made with the compounds employing gaps of 5½, 6, 7, 8 and 9 inches. The discrepancy between the shadows of these compounds still remained. Another test was made with the same compounds, using the Potter-Bucky diaphragm, obtaining the same results.

A number of metallic salts (Fig. 3) were skiagraphed without the water solvent, under the same conditions as were used with the salts in solution. Twenty-five grains of different salts were placed in gelatine capsules, as previously described, and comparisons made with the scale showed that

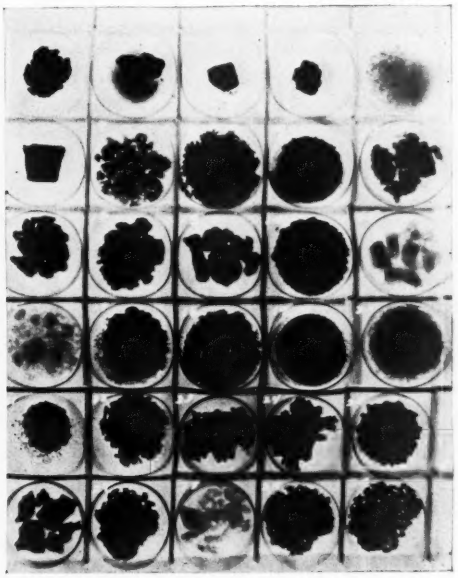

Fig. 3. Representing the metallic salts without the water solvent:

No. 1. Antimony
No. 2. Manganese
No. 3. Cobalt
No. 4. Bismuth
No. 5. Silicon
No. 6. Lead
No. 7. Chromium Nitrate
No. 8. Strontium Chloride
No. 9. Silver Sulphate
No. 10. Nickel Nitrate
No. 11. Cerium Nitrate
No. 12. Copper Bromide
No. 13. Nickel Chloride
No. 14. Antimony Sulphate
No. 15. Aluminum Ammonium Sulphate
No. 16. Aluminum Sulphate
No. 17. Lead Acetate
No. 18. Barium Acetate
No. 19. Molybdic Acid
No. 20. Chromium Sulphate
No. 21. Chromium
No. 22. Strontium Nitrate
No. 23. Copper Nitrate
No. 24. Sodium Iodide
No. 25. Potassium Chromate
No. 26. Ferrous Sulphate
No. 27. Tin Chloride
No. 28. Aluminum Nitrate
No. 29. Manganese Chloride

the salts without the water solvent cast denser shadows than those in solution.

Toxicity—The toxicity is a very important consideration. Some of the metallic salts cast very dense shadows, yet are too toxic to be practical. On the other hand, some of the metallic salts cast dense shadows and are not very toxic, e. g., cerium, of which as much as three drams have been given by mouth without producing any seri-

ous results. There are many metallic salts of great absorbability, the toxicity of which is little mentioned. This opens a fertile field for experimental work. Inasmuch as the consideration of the toxic properties of the metallic salts plays a very important rôle in such experiments, and as this factor in the instance of the rarer metallic salts has been found somewhat difficult to obtain in the literature, it seems justifiable to present a recapitulation of those wherein it has been practicable to do so.

The toxicity (4), (5), (6) of the following metallic salts is set forth in accordance with the degree of absorbability of each, and agrees in this manner with the order given in Table I:

Uranium: Fifteen to sixty grains of uranium chloride given by mouth to a dog produced vomiting only. Three grains of the chloride into the vein proved instantly fatal.

Iridium: Iridium chloride is a poison and acts as platinum, but not so energetically.

Platinum: Twelve grains of the chloride given to a dog killed it in the course of a day, while half that quantity, injected into a vein, proved fatal.

Osmium: Oxide of osmium is an active poison. One and a half grains by mouth will kill a dog in a day, while half that quantity will prove fatal in one hour, if injected in a vein.

Gold: Gold per chloride is a violent poison. A small quantity, when injected in a vein, will kill an animal in a few minutes.

Tungsten: The toxic dose for sodium tungstate, given subcutaneously, is 120 mg. per kg. for dogs.

Thallium: Fifteen and one-half grains of the carbonate killed a rabbit in a few hours; .04 to .06 grain of a soluble salt, injected into a vein, produced death.

Bismuth: Myer and Steinfeld found that bismuth salts, injected subcutaneously in birds or mammals or into the vein in poisonous doses, produced death in from 24 to 48 hours, the fatal issue being preceded by convulsions. One case is recorded of the death of an adult nine days after taking two ounces of bismuth subnitrate, although recovery has followed a dose three times as large.

Lead: In concentrated form and in sufficient amount the soluble preparations of lead are violent poisons. The insoluble preparations of lead are incapable of acting as acute irritant poisons, but are the common cause of a chronic poison.

Cerium: Three drams of the chloride produced no effect on a dog.

Iridium and Rhodium: The chlorides of both metals are poisonous, and similar to platinum, but do not act so energetically.

Palladium: The chloride, given internally, is not more energetic in its action than the corresponding platinum salts, but far more intensely active when injected in a vein. Two-thirds of a grain, when injected into a vein, killed a dog in one minute.

Silver: Metallic silver is not a poison, but the nitrate, when injected into a vein to the amount of 2 grains, killed a dog in six minutes. One-third of a grain caused death in four and a half hours by tetanus. Internally, 36 grains killed a dog in thirty-six hours.

Cadmium: Twenty grains of the oxide given to a dog produced only vomiting.

Antimony: Results secured by Dr. Nevin on eleven rabbits to which doses of one-half to one grain were given four times a day, were as follows: The weakest rabbit died after taking twelve doses; the strongest died after taking 72 grains; one died after four, and another after seventeen days.

Tin: The chloride is an active poison. According to Orfila's experiments, from 18 to 24 grains, given internally to dogs, killed them in one, two and three days, respectively.

Iodine: Four to six grains in man caused a sensation of constriction in the throat, nausea and pain in the stomach, and at length vomiting and colic.

Molybdenum: Thirty grains of the ammonium killed a rabbit in two hours. In dogs, however, it merely produced purging and vomiting, while 10 grains, injected into the jugular vein, will not prove fatal.

Barium: One hundred grains of barium chloride has destroyed life in an adult woman in fifteen hours. Fourteen grams of the nitrate of baryta has killed a man in six hours and a half, and the carbonate of baryta has killed a person in the relatively small dose of 60 grains (3.8 grams). On the other hand, certain Continental physicians have prescribed barium chloride in large medicinal doses. For example, Pirandi and Lisfranc have gradually raised the dose of barium chloride from 4 decigrams to 3 grams (48 grains) daily, given, of course, in divided doses. Pirandi himself took in a day 7.7 grams (119 grains) without any bad effect.

Copper: Six grains of the sulphate by mouth to a dog killed it in thirty minutes.

Arsenic: Fifteen grains of the iodide, injected into the vein of a dog, killed it in twenty seconds. Thirteen grains by mouth killed a dog in two and a half hours.

Nickel: Twenty grains of the sulphate by mouth to a dog produces free vomiting, while 10 grains, injected into the jugular vein, will not prove fatal.

Zinc: Eight drams of the acetate by mouth to a dog caused death in about three days. Injected into a vein, 48 grains produced instant death, and 24 grains caused death in three minutes.

Cobalt: Thirty grains of the oxide proved fatal in a few hours. Three grains of the sulphate, into the vein, proved fatal in four days.

Strontium: Ten grains of the chloride, injected into the vein of a dog, produced no results. Forty grains killed in fifteen minutes.

Bromine: Very few cases of death are reported. One death was caused by 1 ounce of bromine. In another case a child of ten years took about 2 grains of bromine and died.

Titanium: No available experiments upon animals.

Manganese: A feeble poison. One dram fatal to a rabbit in one hour. Twelve grains, injected into the jugular vein of a dog, killed it in five days.

Chromium (Bi-chromate): One grain, injected into the jugular vein of a dog, produced no effect. Four grains caused death in six days, while 10 grains produced instant death.

Iron (Ferric chloride): Gemlin found that 2 ounces of the sulphate, given to a dog by mouth, produced vomiting, but nothing more. Twenty grains in the vein of a dog had no effect, and 40 grains to a rabbit had no effect.

Lithium, Rubidium, and Caesium: On account of their rarity, little is known.

Potassium: *Potassium chlorate*—46 grains proved fatal to a child three years old. The minimum adult dose reported fatal is 3 ounces. Dr. Fountain took $1\frac{1}{8}$ ounces with fatal consequences in seven days. *Potassium nitrate*—though an adult has died from a dose of 2 drams, other cases have recovered from a dose of 10 ounces. *Potassium hydroxide*—the ordinary fatal quantity is 1/20 ounce, but 30 grains have proved fatal.

Calcium: Caustic and irritant poison.

Phosphorus: Very violent poison. One-eighth grain has proved fatal.

Chlorine: When inhaled in small amounts, chlorine causes suffocative feeling and cough. If taken undiluted, it causes difficult breathing, a painful sense of tightness in the chest, and violent cough, with hemorrhage. Fatal consequences are not apt to occur unless the subject is in delicate health, and the gas is taken with little admixture of air. Free chlorine in the proportion of .04 to .06 per thousand, taken into the lungs, is dangerous to life. The effects of chlorine can hardly be differentiated from those of hydrochloric acid gas, and Lahmann found that in the proportion of one and

one-half per thousand this latter gas affected animals, causing at once uneasiness, evidence of pain with great dyspnea and, later, coma.

Aluminum: Paul Sein researches were made on frogs, cats and dogs. For frogs, he employed a double salt, consisting of sodic and aluminic lactate, which, equal to 15.2 per cent of aluminum trioxide to twenty to thirty milligrams, administered subcutaneously, caused death in from ten to twenty-four hours. He found, by beginning with small doses of double tartrate of sodium and aluminum, that the lethal dose for rabbits was 0.3 gram per kilo of body weight; for dogs 0.25 gram, and for cats 0.25 to 0.28 gram. If, however, a single dose was administered, then cats could be killed by 0.15 gram per kilo.

Sodium: Sodium hydroxide—same as Potassium hydroxide.

Boron: Fatal results have ensued in a few cases from injecting boracic acid into abscess cavities and from washing out the stomach with it.

It has not been practical to obtain data relating to the toxicity of the following list, which comprises practically all of the remaining elements: Tantalum, Samarium, Neodynium, Erbium, Praseodynium, Lanthanium, Ruthenium, Tellerium, Indium, Germanium, Selenium, Yttrium, Zirconium, Titanium, Sulphur, Silicon, Fluorin, Beryllium, Lithium, Vanadium.

TABLE II

SOLUBLE METALLIC SALTS

			Absorbability	Comparison with Scale
No. 1.	Uranium Nitrate	$NO_2(NO_3)_2+6H_2O$	118349.362	25
No. 2.	Iridium Chloride	$IrCl_4$	83407.165	—
No. 3.	Platinum Chloride	$PtCl_4+2HCl+6H_2O$	83005.667	—
No. 4.	Osmium Chloride	$OsCl_2$	80085.737	—
No. 5.	Gold Chloride	$AuCl_3+HCl+4H_2O$	77387.006	22
No. 6.	Thorium Chloride	$ThCl_4+8H_2O$	66984.260	23
No. 7.	Sodium Tungstate	$Na_2WO_4+2H_2O$	62387.805	20
No. 8.	Mercury Nitrate	$Hg(NO_3)_2$	56000.031	22
No. 9.	Tantalum Chloride	$TaCl_5$	52588.713	—
No. 10.	Thallium Acetate	$TlC_2H_3O_5$	51653.881	23
No. 11.	Bismuth Chloride	$BiCl_3$	46475.998	22
No. 12.	Ammonium Molybdate	$(NH_4)_2MoO_4)$	39981.100	21
No. 13.	Lead Nitrate	$Pb(NO_3)_2$	35479.130	22
No. 14.	Cerium Chloride	$Ce_2Cl_6+14H_2O$	22565.540	20
No. 15.	Erbium Nitrate	$Er_2(NO_3)_6$	22632.814	16
No. 16.	Rhodium Chloride	Rh_2Cl_6	18813.274	—
No. 17.	Lanthanium Chloride	$La_2Cl_6+14H_2O$	18742.244	18
No. 18.	Samarium Nitrate	$Sm(NO_3)_3+6H_2O$	17432.267	18
No. 19.	Ruthenium Chloride	Ru_2Cl_6	17334.984	—
No. 20.	Neodynium Chloride			20
No. 21.	Praseodymium Chloride	$Pr(NO_3)_3$	10774.717	12
No. 22.	Palladium Chloride	$PdCl_2$	9106.708	—
No. 23.	Silver Nitrate	$AgNO_3$	8846.368	22
No. 24.	Niobium and Potassium Fluoride	$NdOF_32KF+H_2O$	8562.935	—
No. 25.	Cadmium Chloride	$CdCl_2+2H_2O$	8192.941	22
No. 26.	Antimony and Potassium Oxalate	$SbK_3(CO_4)_3+6H_2O$	8008.910	—
No. 27.	Tin Chloride	$SnCl_2+2H_2O$	7421.179	21
No. 28.	Telluric Acid	H_2TeO+2	7092.540	—
No. 29.	Iodine Monobromide	IBr	7067.761	—
No. 30.	Indium Chloride	$InCl_3$	6966.533	—
No. 31.	Zirconium Nitrate	$3ZrO_2+2N_2O_5$	6323.790	—
No. 32.	Barium Chloride	$BaCl_2+2H_2O$	5821.956	21
No. 33.	Caesium Chloride	$CsCl$	2755.465	21
No. 34.	Yttrium Chloride	YCl_3+6H_2O	2140.725	—
No. 35.	Arsenic Chloride	$AsCl_3$	1930.597	—
No. 36.	Copper Chloride	$CuCl_2$	1886.528	13
No. 37.	Chromium Chloride	$CrCl_6$	1824.728	5
No. 38.	Nickel Chloride	$NiCl_2+6H_2O$	1739.835	9
No. 39.	Zinc Chloride	$ZnCl_2$	1645.322	20
No. 40.	Cobalt Chloride	$CoCl_2+6H_2O$	1528.536	10
No. 41.	Germanium Oxide	GeO_2	1470.573	—
No. 42.	Selenous Acid	H_2SeO_3	1449.306	—
No. 43.	Strontium Chloride	$SrCl_2+6H_2O$	1286.474	16

TABLE II—*Continued*

			Absorbability	Comparison with Scale
No. 44.	Manganese Chloride	$MnCl_2+4H_2O$	1081.328	8
No. 45.	Titanium Nitrate	$TiO(NO_3)+H_2O$	1079.092	9
No. 46.	Sodium Bromide	$NaBr$	1051.792	21
No. 47.	Iron Chloride	$FeCl_3+6H_2O$	924.126	9
No. 48.	Rubidium Chloride	$RbCl$	676.769	—
No. 49.	Aluminum Chloride	$Al_2Cl_6+12H_2O$	535.608	5
No. 50.	Tr. Iodine, 7% Iodine		421.8	14
No. 51.	Sulphur Chloride	S_2Cl_2	260.574	—
No. 52.	Calcium Chloride	$CaCl_2$	244.416	6
No. 53.	Potassium Chloride	KCl	183.815	9
No. 54.	Magnesium Chloride	$MgCl_2+6H_2O$	182.467	7
No. 55.	Sodium Chloride	$NaCl$	72.114	—
No. 56.	Lithium Chloride	$LiCl$	61.767	7
No. 57.	Beryllium Nitrate	$Be(NO_3)+3H_2O$	39.153	5
No. 58.	Acid Boracic (Boron)	B_2O_3	22.469	2
No. 59.	Water	H_2O	5.804	1

TABLE III

SOLUBLE METALLIC SALTS

	Two drams of a 20 per cent solution		Absorbability	Comparison with Scale
No. 1.	Uranium Nitrate	$UO_2(NO_3)_2+6H_2O$	118349.362	23
No. 2.	Gold Chloride	$AuCl_3+HCl+4H_2O$	77387.006	22
No. 3.	Thorium Chloride	$ThCl_4+8H_2O$	66984.260	23
No. 4.	Sodium Tungstate	$Na_2W_2O+2H_2O$	62387.805	20
No. 5.	Barium Chloride	$BaCl_2+2H_2O$	5821.52	21
No. 6.	Mercury Nitrate	$Hg(NO_3)_2$	56000.031	22
No. 7.	Thallium Acetate	$TlC_2H_3O_5$	51653.881	23
No. 8.	Bismuth Chloride	$BiCl_3$	46475.998	22
No. 9.	Lead Nitrate	$Pb(NO_3)_2$	35479.130	22
No. 10.	Cerium Chloride	$Ce_2Cl_6+14H_2O$	22565.540	20
No. 11.	Erbium Nitrate	$Er_2(NO_3)_6+12H_2O$	22632.814	16
No. 12.	Lanthanium Chloride	$La_2Cl_6+14H_2O$	18742.244	18
No. 13.	Samarium Nitrate	$Sm(NO_3)_3+6H_2O$	17432.267	18
No. 14.				
No. 15.	Neodynium Chloride			20
No. 16.	Ammonium Molybdate	$(NH_4)_2MoO_4$	39981.100	21
No. 17.	Praseodynium Nitrate	$Pr(NO_3)+6H_2O$	10874.717	12
No. 18.	Silver Nitrate	$AgNO_3$	8846.368	22
No. 19.	Cadmium Chloride	$CdCl_2+2H_2O$	8192.941	22
No. 20.	Tin Chloride	$SnCl_2+2H_2O$	7421.179	21
No. 21.	Tr. Iodine 7%		421.8	14
No. 22.	Zirconium Chloride	$ZrCl_4$	2319.142	16
No. 23.	Caesium Chloride	$CsCl_2$	2752.465	21
No. 24.	Copper Chloride	$CuCl_2$	1886.528	13
No. 25.	Chromium Chloride	$CrCl_6$	1824.728	5
No. 26.	Nickel Chloride	$NiCl_2+6H_2O$	1739.835	9
No. 27.	Zinc Chloride	$ZnCl_2$	1645.322	20
No. 28.	Cobalt Chloride	$CoCl_2+6H_2O$	1528.536	10
No. 29.	Strontium Chloride	$SrCl_2+6H_2O$	1286.474	16
No. 30.	Manganese Chloride	$MnCl_2+4H_2O$	1081.328	8
No. 31.	Titanium Nitrate	$TiO(NO_3)_2+H_2O$	1079.092	9
No. 32.	Sodium Bromide	$NaBr$	1051.792	21
No. 33.	Iron Chloride	$FeCl_3+6H_2O$	924.126	9
No. 34.	Aluminum Chloride	$Al_2Cl_6+12H_2O$	535.608	5
No. 35.	Calcium Chloride	$CaCl_2$	244.416	6
No. 36.	Potassium Chloride	KCl	183.815	9
No. 37.	Magnesium Chloride	$MgCl_2+6H_2O$	182.467	7
No. 38.	Sodium Chloride	$NaCl$, broken capsule	72.114	—
No. 39.	Lithium Chloride	$LiCl$	61.767	7
No. 40.	Beryllium Nitrate	$Be(NO_3)_2+3H_2O$	39.153	5
No. 41.	Acid Boracic	B_2O_3	22.469	2
No. 42.	Bone Meal			
No. 43.	Water	H_2O	5.804	2
No. 44.	Empty Capsule			

SUMMARY AND DISCUSSION

The practical application of these results would appear to be of value to those who are engaged in experimental work. A list of the soluble metallic salts, their absorbability and toxicity, as far as the writer was able to gather, is furnished, with scale for comparison. By knowing the chemical for-

mula of any substance, it is an easy matter to find its approximate absorbability and the approximate shadow it will cast. Let us examine sodium bromide, as an example. The formula is NaBr. Referring to Table I, we find that sodium has an approximate absorbability of about 10.463, and that of bromine is 1041.329. Therefore, adding the absorbability rate of the atom of sodium to that of bromine, we find that the molecule sodium bromide has an absorbability of 1051.792. Let us now examine silver nitrate, $AgNO_3$, having three atoms of oxygen in the molecule to one of nitrogen and one of silver. Referring again to Table I, we find that silver has an absorbability rate of about 8825.627, nitrogen of 3.332, and oxygen of 5.803, and as there are three atoms of oxygen, we multiply the rate of oxygen, 5.803, by 3, and we obtain 17.409. By adding the different figures of absorbability of silver, nitrogen and oxygen, we then find that silver nitrate, $AgNO_3$, has an approximate absorbability of 8846.368, three times greater than sodium bromide. By this means one can avoid the tedious and arduous task of making unnecessary skiagraphs of chemicals of unknown absorbability, by finding the approximate shadow the chemical will cast for the experiment at hand.

In certain instances difficulties have been encountered to show an experimental relationship between the density of shadows cast by various chemical compounds examined and their calculated values, derived from the absorption number of the individual elements entering their composition. It is realized that comparable results can be procured only under set conditions for all the compounds examined. For instance, the same solvent, as well as identical concentration of solution, should obtain equally in all cases. Aside from this, the question of the effect of ionization as well as association of the compounds in solution upon the absorbability is one to be considered and investigated.

Many of the compounds examined contained so-called water of hydration, and in different proportions made a variation in the percentage of these compounds in the solution. For instance, a 20 per cent solution of barium chloride crystals with two molecules of water of hydration ($BaCl_2 + 2H_2O$) would actually contain a smaller quantity of barium chloride than one composed of the anhydrous salt which is water-free. This leaves no doubt that two such solutions will vary in the shadow cast. This might be obviated by weighing out all compounds calculated on a water-of-hydration-free basis. As an example, in the case just cited, barium chloride crystals contain 85.4 per cent of $BaCl_2$, the rest being water, whereas the anhydrous salt is 100 per cent $BaCl_2$. It can be seen, therefore, that in order to make two 10 per cent solutions of $BaCl_2$ from these salts it would be necessary to take 11.7 parts of the former and 10 parts of the latter, respectively, in 100 parts of water.

Many of the compounds tested dissolved with considerable difficulty in water, the solvent chosen, which made it necessary to add small quantities of various acids to prevent hydrolysis of the compounds, and which probably introduced certain factors tending to cause variation in results. Further, several of the substances were exceedingly hydroscopic, making it almost impossible to weigh them rapidly enough to eliminate any absorption of moisture from the air.

The selection of a container to hold the solutions during skiagraphing was another important problem to be met. Glass vials were at first attempted, but it was evident that variation in the thickness of the glass would cause, in itself, slight differences in shadow cast. The use of the inverted tops of gelatine capsules as containers, eliminated most of the objections presented by glass. Occasionally, however, rapid softening of the gelatine occurred, in a very few instances permitting the escape of the solution.

CONCLUSIONS

1. A reference table is herein given of approximate absorbability of the elements,

which is useful in computing the approximate absorbability, or shadow cast, of any chemical.

2. The comparison of shadows cast by compounds in solution to a metallic scale offers a standardization of these shadows.

3. From a study of the experiments conducted, a few of the compounds in solution show a discrepancy when compared with their absorbability rate.

4. The value of the application of the metallic salts in solution depends not only upon the shadow cast, but whether or not it is toxic.

5. The results obtained clearly demonstrate the relationship between the shadows cast and their absorbability rate for most of the compounds; the few discrepancies existing may be obviated in future experimental work.

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Roentgenotherapy for tonsillitis.—Investigators who have removed tonsils and adenoids some weeks or months after X-ray treatment, report that they are unable to find any evidence of active destruction of lymph tissue. According to the author, such investigation should be made when shrinkage and drainage are actually taking place and not after the cells destroyed by the roentgen ray have been absorbed. The absorption of lymph elements produces not only a shrinkage from within but promotes eversion and drainage of the infected crypts. Another important factor in the effect of the X-rays on infected tissue is the biochemical changes produced in the area exposed to radiation, which interfere materially with the progress of the invading bacteria. The shrinkage and drainage of the structures involved in chronic pharyngitis and tonsillitis are dependent on the relative amount of radio-sensitive cells and fibrous cells present. The large soft tonsil reveals the most spectacular results. The small fibrous tonsil containing relatively less radio-sensitive tissue and being smaller in size, shows less marked changes.

The author concludes that X-ray treatment given before operation materially lessens the amount of dissection necessary for the removal of tonsils, thereby decreasing the possibility of complications. Roentgenotherapy is recommended in the following cases: (1) When an anesthetic or operation is contra-indicated; (2) for patients past middle life when hemorrhage might cause complications due to a mild or severe arteriosclerosis; (3) for patients whose tonsils are embedded in infected tissue in which the operation may cause dissemination of septic emboli into the blood and lymph stream, thus producing lung abscess, septicemia, endocarditis, and so forth; (4) for patients whose adjacent lymphatic structures (not removable by operation) are markedly infected; (5) for patients suffering from chronic cardiac lesions, Bright's disease, diabetes, exophthalmic goiter, chorea, rheumatism, hemophilia, asthma, tuberculosis, status lymphaticus, or any condition which has lowered the general condition; (6) for patients subject to frequent attacks of peritonsillar abscess; (7) for vocalists and public speakers subject to frequent attacks of tonsillitis and pharyngitis, and (8) for patients suffering from recurrent attacks of pharyngitis after removal of the tonsils and adenoids.

J. D. Camp, M.D.

Indications for Roentgen Therapy in Chronic Tonsillitis and Pharyngitis. W. D. Witherbee. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 331.

CIRRHOSIS OF LUNG[1]

Chronic Diffuse Interstitial Fibrosis

By L. R. SANTE, M.D., Associate Professor of Radiology, St. Louis University Medical School

CIRRHOSIS of the lung has long been known and was described many years before the advent of X-ray. "Under this title may be included all of those conditions which are essentially a replacement fibrosis of the lung and which are known variously as cirrhosis, sclerosis, or fibrosis of the lung; organizing or chronic indurative pneumonia, chronic interstitial pneumonia, or fibroid phthisis" (1). This variety of names suggests numerous different conditions, indicating that "replacement fibrosis of the lung" is rather a pathological process than a definite disease entity. In the past it has been considered by many authorities that a primary interstitial pneumonia, or cirrhosis, did exist as a definite disease; in recent years, however, there is more and more indication that the condition is always secondary to some other pathological process in the lung. Jacobi (2) says in this regard: "There are those, like Stoffela, in whose opinion interstitial pneumonia is never primary; or, like Eichhorst, who believe it is mostly secondary. In Jürgensen's opinion interstitial pneumonia is not a clinical, but an anatomical, entity." Tice (3) in his "Practice of Medicine" says: "It is no longer considered a disease entity, but is the product of inflammation, or irritation, arising from many causes. The term 'fibroid phthisis' should be applied only to cases in which fibrosis is the result of tuberculous infection."

The causes of interstitial fibrosis have been ascribed to many conditions by clinicians. (1) In a few instances it was thought that interstitial fibrosis was a primary disease of the lung. (2) Many cases follow pneumonia, both lobar and broncho, usually where suppuration has resulted from the pneumonic process. (3) In a great many instances the condition follows plastic fibrinous pleurisy, usually associated with a purulent exudate. (4) The condition is encountered occasionally as a manifestation of syphilis. (5) An atelectatic condition of the lung, caused by pressure of a tumor mass, or aneurysm, is spoken of by some as an interstitial pneumonia, but bears none of the radiographic or pathologic appearances of chronic interstitial pneumonia of the inflammatory type. (6) The fibrosis following long-continued dust inhalation is referred to as chronic interstitial pneumonia, but does not resemble, and bears no relationship to, the inflammatory type. (7) The fibrosis associated with a long-standing tuberculous lesion is referred to as chronic interstitial pneumonia, and may be impossible of differentiation from the inflammatory type. The presence or absence of tubercle bacilli in the sputum is the decisive factor.

In the cases referred to as primary involvement of the lung, roentgen-ray evidence is lacking, the entire supposition being based on clinical observations. It is possible that some cases so observed were of the syphilitic type. Until such a condition is seen at its onset and is followed through its entire course by serial X-ray examination, the primary character of such a condition must remain in doubt. Merely because a patient has no history of critical illness, during which he has been incapacitated, does not mean that the condition did not have its inception in a previous pneumonia, abscess or other pyogenic lesion. We have seen patients with well-defined abscesses of the lungs where there was no history of acute illness and where the individual had not lost a day's work for several years. Such abscess may, by bronchial dissemination, within one week, completely infect the lower lobe or entire lung and result ultimately in interstitial fibrosis, com-

[1] From the Departments of Radiology of St. Mary's Hospital, and the St. Louis City Hospitals. Paper read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923.

pletely obliterating all lung structure (4) (5). In our own experience we have never encountered a single case in which the fibrotic process was not the result of previous demonstrable infection.

Most of our cases followed previous suppurative process as the result of pneumo-

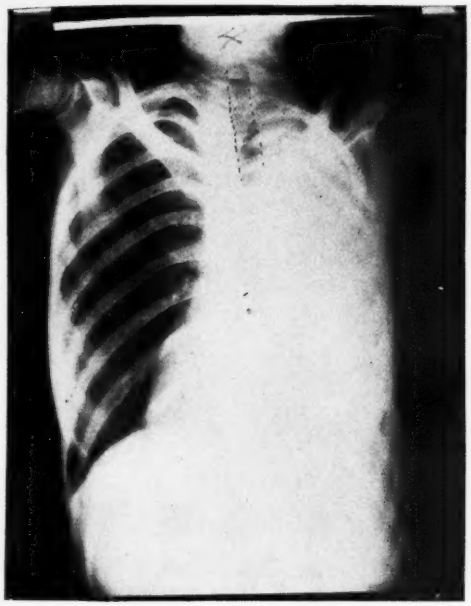

Fig. 1 (*a*). Chronic diffuse interstitial fibrosis following influenza pneumonia, showing the characteristic appearance after two years' duration. Note the dense consolidation of the entire right lung, narrowing of the interspaces, and retraction of the heart and mediastinal structures to the right. (Tracheal displacement is evident.)

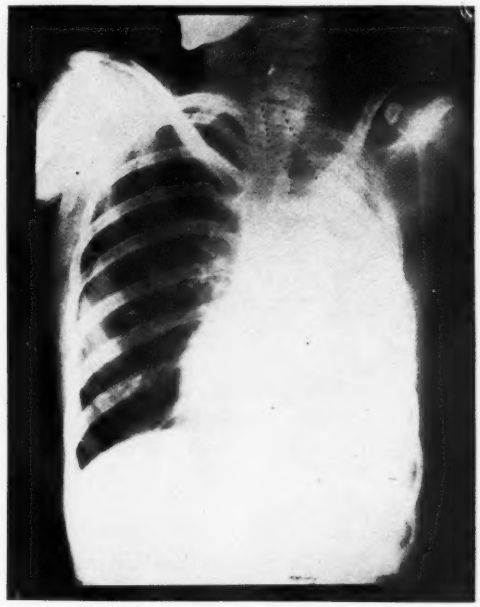

Fig. 1 (*b*). Same patient as Fig. 1 (*a*), about eighteen months later, showing little change in the process other than an increase in the degree of retraction. Numerous small abscess cavities, discernible on the plate, do not show on the reproduction.

nia, or its complications. This report is based on nine such cases encountered at the St. Louis City Hospitals and St. Mary's Hospital during the past five years. Small fibrotic areas resulting from infection, although essentially of the same pathological character, do not, by reason of their limited extent, produce the same radiographic appearances and clinical difficulties presented by the diffuse lesion involving an entire lung, and are not included in this report. With but two exceptions, all of these cases of diffuse interstitial pneumonia could be traced to some pyogenic infection in the chest. The fibrotic process followed two methods of invasion, either starting in the lung or in the pleura. Where the primary process occurred in the lung, the condition usually followed small abscess formation, either resulting from pneumonia (either lobar or broncho), or primary in the lung. Abscess formation following broncho-pneumonia, being usually multiple and small, is more apt to give rise to this condition than the abscess formation which follows lobar pneumonia, since the abscesses resulting from this type of pneumonia are more apt to be larger and fewer in number. The fibrous tissue deposit about the abscess is merely Nature's effort to wall off an area of infection. If the pus is not drained through connection with a bronchus, or by some other means, the constantly increasing deposit of fibrous tissue in the lungs will immobilize more and more the surrounding lung tissue. This immobilization in turn is a more favorable condition for fibrous tissue deposit, establishing a vicious circle. In this manner,

Nature, at first endeavoring only to wall off an infectious process in the lung, may outdo herself and completely disable an entire lung. Fibroblasts invading the lung tissue not only involve the interstitial tissue

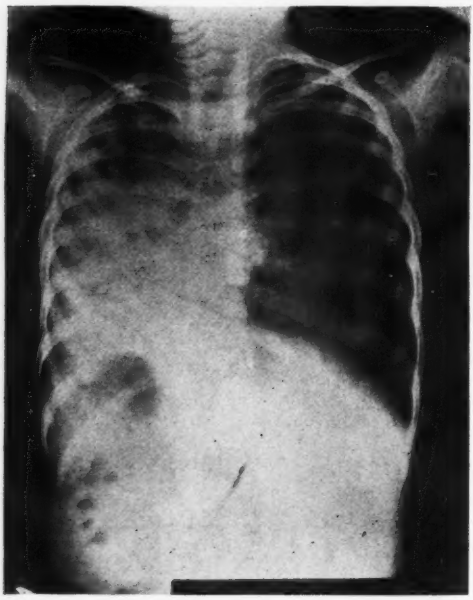

Fig. 2. Chronic diffuse interstitial fibrosis following broncho-pneumonia at the age of 18 months. The condition has been present for four years since, with little apparent change. Numerous cavities are present in this instance. Tubercle bacilli were never found in the sputum. Note the retraction of the heart and trachea and narrowing of the interspaces.

of the lung, but creep in between the cells and invade the alveolar spaces, filling the alveoli. New-formed blood vessels grow out into the fibrous deposit and organization takes place. With organization and scar tissue formation, contraction occurs, similar to scar tissue contraction elsewhere in the body. The contraction gives rise to certain manifestations in the X-ray plate, which are characteristic of the condition. The heart and mediastinal structures are pulled over to the affected side, the diaphragm is pulled upward and the intercostal spaces are narrowed. The well-walled-off abscess cavities often remain for a long time and give rise to a mottled, uneven appearance of the entire lung involved. Usually the lesion is unilateral, the other lung, with the exception of compensatory emphysema, appearing fairly normal.

Observations of others likewise indicate that the condition most frequently follows

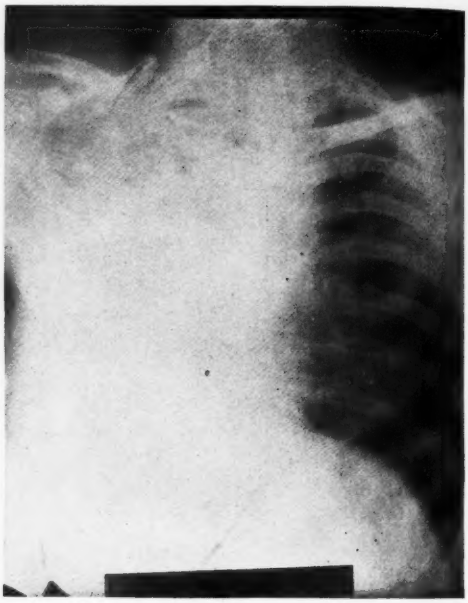

Fig. 3. Chronic diffuse interstitial fibrosis following lobar pneumonia. Evidence of beginning retraction of the mediastinal structures is present, but the process is too recent to venture a definite opinion as to the ultimate outcome.

pneumonia. Lord (6) reports 16 out of 210 autopsies on lobar pneumonia patients, or 7 per cent; and 12 out of 85 on broncho-pneumonic patients, or 14 per cent. Frankel found 7 cases in 1,000 autopsies on broncho-pneumonic patients, and Milne (7) 10 cases out of 159 autopsies on pneumonic patients, 6.2 per cent (type not stated).

Since broncho-pneumonia would seem to be the type of pneumonia most conducive to the formation of this condition we would expect numerous instances of interstitial fibrosis to follow influenza pneumonia cases, and, in truth, this has been noted. Several of our cases followed influenza broncho-pneumonia, and a number of instances are recorded in the literature (8). MacCallum (9) has described an "intersti-

tial pneumonia following measles where exudation occurs early in the disease"—this may be due to an early suppuration incident to broncho-pneumonia of measles.

Frequently the process follows a plastic fibrinous pleurisy associated with a thick, purulent pleural exudate. The pleurisy itself may have been incident to a previous pneumonic process—the pneumonic consolidation being completely resolved, leaves an irregular ragged area of increased density near the periphery. Here again, if the area involved is small, the process may take care of itself, ending by absorption and complete resolution and restoration to normal, but if more extensive involvement is present, small areas of pus become entrapped between dense fibrinous strands of organizing exudate and become permanently isolated. Here, as in interstitial pneumonia resulting from suppuration within the lung, the fibrosis may extend beyond the limits of usefulness and invasion of the lung may take place. Later organization, scar tissue formation and contraction give rise to a similar picture and to a condition quite similar pathologically to the condition resulting from fibrosis following lung suppuration. Whether pulmonary or pleural in origin, the condition always seems to follow some chronic confined suppuration in the chest. Large area may be involved and it may appear for a time as if organization and diffuse chronic interstitial pneumonia were inevitable, when, by a complete removal of the pus through a final absorption, the process resolves—the new-formed fibrinous exudate resolves before organization takes place and the lung is restored to normal. If organization has taken place, if new-formed blood vessels have grown out into the fibrinous exudate and scar tissue has formed, there is no longer hope of absorption and restoration to normal.

In the X-ray the presence of scar tissue formation is evidenced by retraction of the heart and mediastinal structures, and when this condition is once established resolution of the consolidation is impossible and the patient is condemned to chronic invalidism. That this condition may continue for several years without material change is evidenced by our observation in several cases. Usually, however, it results in death after a few months or years.

There is no form of treatment which seems to offer any hope. Surgically, if

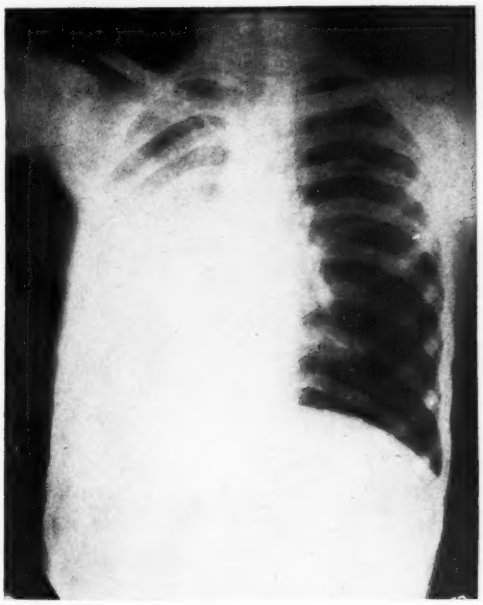

Fig. 4. Chronic diffuse interstitial fibrosis following plastic fibrinous pleurisy. Note the narrowing of the interspaces and retraction of the mediastinal structures —the same as when the condition is pulmonary in origin.

needling results in aspiration of one small pocket of pus there remain hundreds of others which can not be reached. Likewise, needling is dangerous in these patients on account of the marked vascularity from new-formed blood vessels and the confined character of the underlying structures, the fibrous tissue holding everything firmly in place. Three instances of death from hemorrhage following attempted aspiration in such cases have come to the attention of the essayist. It is possible that if detected early, before organization is fully established, X-ray treatment may offer some hope.

Syphilis has been credited with the formation of a chronic diffuse interstitial

pneumonia, both in newborn infants and in adults. In newborn infants, the condition is known as "white pneumonia," presenting ample pathological evidence of its syphilitic origin. That a similar chronic interstitial pneumonia of syphilitic origin occurs in adults, however, has never been definitely proven. Until spirochetes are found in such consolidations, the condition will never be proven of syphilitic origin. Sufficient evidence is found in the literature, however, to suggest that this condition may be of syphilitic origin. Radiographically, also, several cases have been cited which are suggestive of the luetic type of this condition. Golden (10) illustrates three cases as of luetic origin, showing dense fibrosis of an entire lung with retraction of the heart and mediastinal structures with evidence of cavity formation, which, however, did not show evidence of material change over a period of years, and which did not disappear after antiluetic treatment. Even if the condition were luetic in origin, one would scarcely expect disappearance of the scar tissue following antiluetic treatment, any more than the scar following gumma elsewhere in the body or other tertiary lesions, such as tabes dorsalis.

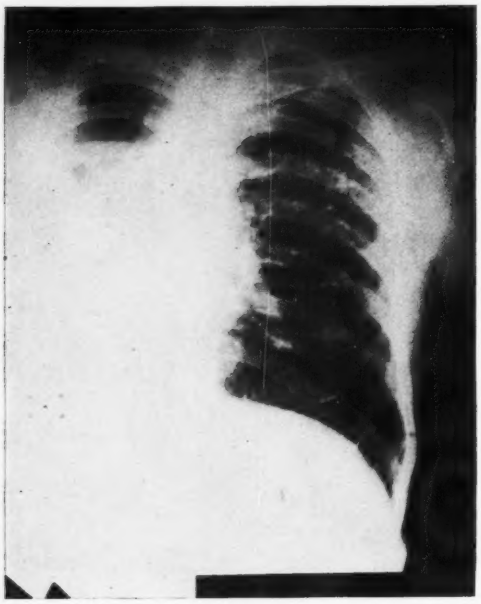

Fig. 5. Chronic diffuse interstitial fibrosis occasionally becomes so pronounced in the course of a tuberculous involvement that it is practically impossible to distinguish it from the inflammatory type. Evidences of tuberculosis elsewhere in the chest and pronounced cavity formation, together with the presence of tubercle bacilli in the sputum, make the diagnosis plain. Note the evidence of tuberculous dissemination in the upper right lung, also the large cavity in the upper left.

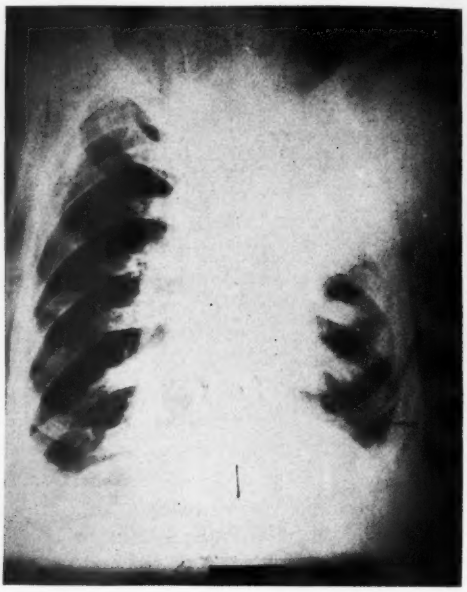

Fig. 6 (*a*). Chronic diffuse interstitial fibrosis has occasionally been attributed to a syphilitic involvement. The case illustrated was very suggestive of this type. At the time this radiograph was taken, the condition had been present for about two months. Onset was gradual without fever, pain or other disability. Condition was at first thought to be due to a tuberculous pneumonia, but as time went on without material change the possibility of syphilitic involvement presented itself. Wassermann was 4+ positive.

Watkins (11), in a paper on "X-ray Shadows of Lung Syphilis and Syphilitic Tuberculous Symbiosis," illustrates a similar case with dense fibrosis of an entire lung, but apparently without retraction of the heart and mediastinal structures, or other evidence of scar tissue formation. It is possible that this may represent the stage of fibrinous invasion prior to organization and scar tissue formation, and, if so, disappearance can logically be expected, if anti-

luetic treatment is given prior to the stage of scar tissue formation and retraction. It is noteworthy, also, that there is no evidence of cavity formation, the entire shadow presenting a homogeneous appearance, indicating that actual tissue destruction has not occurred. It is possible that at a later stage of the disease cavity formation may result from localized bronchial dilatation, such as indicated in the cases illustrated by Golden.

If these cases are true manifestations of syphilis, they bear a striking resemblance to cases of chronic interstitial pneumonia of inflammatory origin and can scarcely be differentiated from them radiographically after scar tissue formation has occurred and cavities have been formed, as illustrated by cases shown by Golden. If, on the other hand, the process is encountered early, before organization and scar tissue formation has occurred, the homogeneous appearance of the lesion without mediastinal retraction or cavity formation should make one suspicious of the luetic origin of the condition—as illustrated by Watkins.

We have never encountered interstitial pneumonia following compression of the bronchi by neoplasms, or aneurysms, and while theoretically an atelectatic condition of the lungs might result from such cause, it must be a very rare occurrence, since, with large aneurysms and newgrowths practically filling the chest, no such picture has been presented. The findings likewise would hardly be those of interstitial pneumonia, and pathologists inform us that in atelectatic conditions there is not an invasion of the air cells by new-formed fibrous tissue, but merely a collapse of the alveoli, the respiratory membrane being every-

Fig. 6 (*b*). Examination three weeks later (same case as Fig. 6, *a*) showed little, if any, change; the same diffuse homogeneous character of the process, without evidence of cavitation or indication of scar tissue contraction, was still present. Under the supposition that the condition was due to a syphilitic involvement, 606 was given.

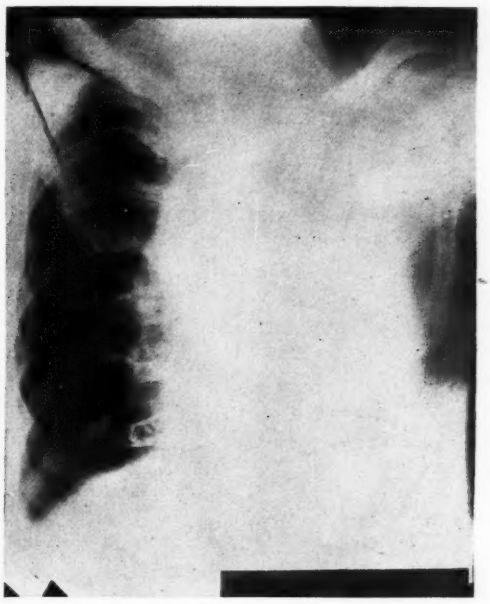

Fig. 6 (*c*). Examination two days after the administration of 606 (same case as Figs. 6, *a* and *b*) showed the rapid advance of the consolidation to involve the entire lung. There was no accompanying discomfort or disability; no leukocytosis; the shadow still preserved its homogeneous appearance and showed no evidence of cavity formation, or mediastinal retraction. Examination for four weeks subsequent to this showed no material change. Autopsy revealed the condition to be due to primary carcinoma of lung. At this stage it might have been mistaken for chronic interstitial pneumonia.

where intact. Contracted lungs from long-continued pressure by pleural effusions do not present the same radiographic picture.

The fibrosis incident to dust inhalation (12), although the term "interstitial pneumonia" is applied to it, does not in any way resemble diffuse chronic interstitial pneumonia. The fibrosis, being largely peribronchial in origin, does not present the dense mass of fibrous tissue involvement encountered in the inflammatory type of chronic diffuse interstitial pneumonia.

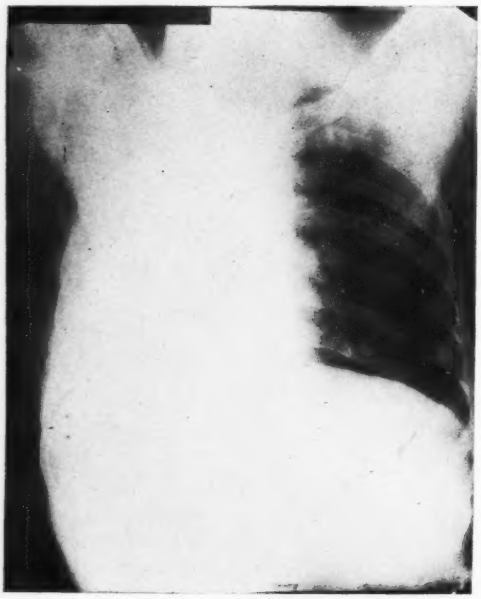

Fig. 7. Owing to the extreme vascularity of the organizing fibrous tissue and the confined condition of the lung from scar tissue formation, needling for attempted aspiration becomes very dangerous. Three instances of fatal hemorrhage have come to the author's attention following attempts at aspiration.

The fibrous tissue deposit associated with tuberculosis is sometimes so pronounced that it may simulate diffuse interstitial pneumonia and, indeed, is of the same pathological nature. It rarely attains the proportions of diffuse interstitial pneumonia, however, and other evidences of the tuberculous nature are usually present, establishing readily the true nature of the disease.

From a consideration of the pathologic and radiographic evidence concerning the character of the lesion cited in this wide variety of conditions, it would seem that the condition is most comprehensively described by the term "chronic diffuse interstitial fibrosis of the lung."

SUMMARY

1. Replacement fibrosis of the lung was known long before the advent of the X-ray.

2. This condition is referred to under many different names, notably: cirrhosis, sclerosis, or fibrosis of the lungs; organizing or chronic indurative pneumonia; chronic interstitial pneumonia, or fibroid phthisis. The very names are suggestive of a wide variety of lesions.

3. The condition has been ascribed to many causes by clinicians:

(*a*) Primary in the lung without previous demonstrable cause.
(*b*) Following pneumonia, both lobar and broncho, or their complications.
(*c*) Following fibrinous pleurisy.
(*d*) Occasionally as a manifestation of syphilis.
(*e*) Associated with atelectatic conditions of the lung from pressure by large tumors, or aneurysms.
(*f*) Following chronic dust inhalation.
(*g*) Fibrosis associated with long-standing phthisis.

The pathology present, as well as the X-ray findings, varies widely in the types of so-called interstitial pneumonia represented in these conditions.

4. Our study is based on nine cases of this type. Nearly all of our cases followed one of two causes, being either pulmonary in origin, following lobar or broncho-pneumonia, or their complications, or having origin from a plastic fibrinous pleurisy.

5. In no instance was the process observed as a primary lesion without evidence of previous infection.

6. Atelectasis, long-standing collapse of lung from pressure by fluid, chronic fibrosis from dust inhalation, and fibrosis incident to tuberculous involvement are essentially different processes and should not be included in this type of lesion.

7. The most expressive term which presents itself for the description of the condition outlined is "chronic diffuse interstitial fibrosis of the lung."

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Radiation of the long bones.—Four series of experiments were performed bearing on the effect of X-rays on bone marrow. The data secured from certain experiments indicated that varying doses of X-rays have little or no effect on the bone marrow of long bones, when applied directly over these long bones. This would be evidence against the practice of treating the leukemias by X-radiation over the long bones. It should be considered, however, that these experiments dealt with marrow practically in a normal state of balance, while in the leukemias, the marrow is in an abnormal state and filled with large numbers of immature cells. The same applies to the treatment of polycythemia, by radiation over the long bones. The reaction of abnormal bone marrow may be entirely different from that of normal marrow. Results of one experiment suggest the possibility of influencing the bone marrow much more readily through X-rays applied over the spleen, than through direct application over the bones themselves. It is possible that radiation over the spleen by exposing the blood cells directly to the action of the X-rays, results in increased blood destruction and the products of the destroyed and disintegrated blood cells may directly stimulate the bone marrow. It is a question whether or not it is possible to depress the bone marrow by large doses of X-rays applied over the spleen, and until more is known of why the spleen may at one time destroy large numbers of red cells, as in the hemolytic icterus anemias, and at other times proliferate large numbers of white cells, as in myelogenous leukemia, it will be difficult to work out the methods of influencing bone marrow in a constructive way through the spleen.

The following conclusions are made: (1) direct X-radiation of the long bones of the dog, in both light and heavy dosage, did not appreciably stimulate or decrease the contained marrow cells; (2) repeated smaller doses of X-rays over the spleen caused a slight increase in the number of cells in the marrow of the long bones of the dog, also there was noted an increase in the proportion of immature marrow cells; (3) X-radiation over the spleen produced a rise in the number of platelets in the peripheral circulation, which rise was maintained during the experiment, and (4) the general condition of both animals was improved during the experimentation, and the hemoglobin and red cells increased.

The article is well illustrated by photo-micrographs, charts and one colored plate.

J. D. Camp, M.D.

The Effect of X-rays on Bone Marrow. E. H. Falconer, L. M. Morris, and H. E. Ruggles. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 342.

NASAL ACCESSORY SINUSES IN INFANTS AND CHILDREN[1]

By BUNDY ALLEN, M.D., Iowa City, Iowa

THE anatomical development and function of the nasal accessory sinuses have been subjects of much investigation. To date, few definite conclusions have been drawn.

Nasal sinusitis in infants and young children unquestionably is of greater significance than is evident in the literature.

The cases we wish to discuss at this time range, as infants, from birth to two, and as children, from two to twelve years of age.

Quoting White, "The time is here, the place everywhere, and the obligation everyone's to serve in the cause of national upbuilding through child welfare, for the child is the embryo of the nation's progress, and the parent of the future generation, the *potential citizen*. From birth to seventeen or eighteen years of age the human economy undergoes its most rapid growth and physiologic changes, and, naturally, if predisposing causes for chronic or semichronic diseases or conditions can be eliminated during this period, what a vast amount of good may be accomplished."

Emphasis may be placed on the importance of the X-ray examination in eye, ear, nose, and throat practice in view of the fact that a very high percentage of infections in the body have their origin in the tissue above the clavicle.

The complexity of the adult nasal cavities is produced by the formation of ridges and pouches on the lateral walls of the original nasal pits. The cartilaginous character of these folds becomes apparent at the end of the second, or the early part of the third month. All evagination on the lateral wall of each nasal fossa, between the middle and inferior turbinate processes, becomes the Antrum of Highmore; this is formed in the sixth month. Other evaginations produce the ethmoids, also the frontals, and the sphenoidal sinuses, which are not completed, however, until after birth.

For a detailed report of accessory sinus variations I will refer you to Dr. Prentiss. This paper is presented with the hope of emphasizing the importance of the more or less routine X-ray examination of the sinuses, and not with the intention of discussing technic. However, it may be timely to say that we are sure that better results may be had if the roentgenologist and the head specialist adopt a technic as their standard from which readings may be of a greater value. The position and angle of the ray should always be the same, so there will be no confusion by unusual distortions.

FRONTAL SINUS

The average plate shows the right and left frontal sinus. One or more sinuses may be present on each side normally or abnormally outlined, or there may be an absence of one or both sinuses. The character of the shadow cast by a sinus is dependent on the density of the material through which the ray passes. The plate, therefore, will show the sinus anatomy and the degree of pathological involvement or other developmental variation. A dense shadow may be due to sinusitis and empyema, a shallow cavity, or thickened anterior plate of bone, a diseased and thickened lining membrane, a periostitis, a luetic bone or osteomyelitis, or an absence of a sinus. A frontal sinus may be any size or shape. The sinuses are formed by extension of an ethmoid cell and vary greatly as this process has more or less invaded the frontal bone. "This may be well advanced at the end of the first year but usually has not materially excavated the frontal bone at this early time. Consequently at birth or during the first year, an involvement of the future frontal sinuses or ethmoid cells would clinically be an anterior ethmoiditis."

According to good authorities, the frontal sinus has clinical significance at the age of

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1922.

five years. Killian reports operation on the frontal sinus of a child fifteen months of age. E. Meyers reports operation on a child three and one-half years of age. Dr. L. W. Dean, in his paper, states that frontal sinus invasion during childhood has been very rare. In his service, the youngest child with frontal sinusitis was seven years of age. He has never found it necessary to operate on a frontal sinus in a child under twelve years of age.

The density of the shadow in an empyema case does not necessarily indicate the character of the purulent material contained within the sinus. The shadow may be very dense or of an indefinite character, and at operation the material found may be thick and tenacious or thin and watery. It is a rare exception, however, to have a clear negative plate of the sinuses and find at operation a pathological condition of consequence,—vacuum sinusitis, of course, excluded. Vacuum sinusitis, however, is not in reality a pathological condition of the sinus. The obliteration, or at least a disturbance of the drainage system, is the pathology. A shadow shown in the shallow frontal or the thickened plate of bone over the sinus in many instances is very suggestive of a pathological involvement. To differentiate, it is necessary to have a lateral view. The lining membrane has been found in many cases to be thickened as much as eight times the normal. A periostitis, an osteomyelitis, a luetic or tuberculous involvement of the frontal bone over the sinus will show an apparent sinusitis which may be interpreted or differentiated only by those experienced in the observation of a large number of sinus plates. Multiple sinuses must be carefully studied before operation, due to the fact that the sinus may be operated upon, curetted, and one or more of the involved sections may be left unopened. The same is true of the anterior and the posterior orbital sinuses.

ANTRA

The maxillary antrum, like the frontal sinus, will, of course, show blurring according to the condition present. The maxillary antrum is in all probability more uniform in all patients than any other sinus.

Dr. E. E. Hughes reports a case in a baby three weeks old, with an empyema of the left antrum.

ETHMOIDS

The anatomy and pathology of the ethmoids, practically in all cases, casts a shadow in direct comparison with other sinuses. The incomplete development and dense bone formation in children, however, is not sufficient to make the positive findings altogether dependable,—the negative or clear plate only is diagnostic.

SPHENOIDS

The information revealed in the examination of the sphenoid is probably the most unsatisfactory as compared with any other sinus of the head. We have found that the lateral stereoscopic view reveals practically all that can be seen in this sinus and posterior ethmoids.

The vertical method of examination of the sphenoid, as used by Dr. George E. Pfahler of Philadelphia, we have found of value in adults. We have found the vertical method of examination of the sphenoid in children very impractical, due to the fact that children can not be induced to hold the film, neither can the film be held satisfactorily for the exposure. Either method of examination is of practical value only when the sinus is clear or negative. If a blurred outline of the sinus can be seen, then the condition may be differentiated from that of a solid bone.

MASTOIDS

The mastoid plate to the otologist is one, if not the most important single, aid in diagnosis. Special importance should be placed on the observation of the plate before performing a mastoidectomy. The greatest value in the mastoid plate is in demonstrating the anatomical distribution and cell structure. The invaluable essential to the otologist is in the type of cells

shown on the plate. The number of cells may be very extensive. In not a few cases, the cells have been found to extend into the zygoma. The mastoids are ordinarily classified into about three groups: pneumatic, deploic and mixed. Naturally, the infantile type of mastoid should be considered in this group. Law, Beck and others have stated that the types of cells in mastoids are uniform, or at least similar on the right and left sides. We have found, however, that probably the majority of cases have at least a variation, and in many cases patients have a large pneumatic type of mastoid on one side, with a sclerotic or infantile on the opposite. The type of cell in a case of mastoiditis, we consider most important. For a more detailed report relative to the type and method of stereoroentgenograms of the mastoids, I would refer you to my article, "Mastoid Stereoroentgenograms Presenting Variations."[2] The patient with a large pneumatic type of mastoid cell, infected, will invariably show clinical signs and symptoms of mastoiditis. If the mastoid cell is of an infantile type, the clinical evidence, as a rule, is not equal to the severity of the involvement. These two statements may be substantiated from the fact that in the large pneumatic type of mastoid there is a thin plate of bone over the cell, with a corresponding thick bone between the cell and the brain. The reverse is true in the infantile type. Therefore, the patient may have a critically involved mastoiditis showing no external evidence of involvement, due to the very thick, dense layer of bone over the mastoid cell, if any be present; while a very thin shell between the mastoid and brain is being undermined by the infection developing meningitis.

The abstracts of the following cases, we feel, are of sufficient interest to report at this time. Many other cases have been seen, examined and treated in a very similar manner, with equally satisfactory recoveries.

Case No. 1. T. E., age three years, entered the Orthopedic Department, University Hospital, November 6, 1918.

Arthritis or involvement of the right ankle and wrist.

January 8, 1918, seen by Orthopedic Department, with condition very much improved.

November 14, 1918, tonsils and adenoids were removed, with no improvement.

Later the sphenoids and ethmoids were drained, following which the arthritis of the wrist and ankle was much improved.

July 9, 1923, the patient has had no symptoms for past year. Discharged from Orthopedic Department as cured.

Dr. Dean's report: Infection of the paranasal sinus in infants and young children is the frequent cause of death.

Case No. 2. An infant, two months of age, was brought into the service in an extremely critical condition, with a hemolytic streptococcic infection of paranasal sinuses and ears. The mastoids were drained, with improvement. The paranasal sinus disease was treated. When the infant died, the opinion was given that the cause of death was paranasal sinus disease. At autopsy the mastoid wounds were clean; the superior and inferior meati of each side of the nose were filled with large accumulations of pus, which seemed to come from the paranasal sinuses under pressure. In each maxillary sinus pus, under great pressure, was found. A complete general examination was made, with negative findings. The cause of death was reported as paranasal sinus disease.

Case No. 3. Another infant, six weeks of age, with a similar history, died while under treatment for paranasal sinus disease of streptococcic origin. When an infant, two or three months of age, is brought into the service with a temperature of 105½, due to paranasal sinus disease, and the child is seen early, before the gastro-intestinal disturbances are marked, the prognosis is very good. If the treatment is begun after the child has reached the stage where it will no longer take nourishment itself, the prognosis is very bad.

[2]Am. Jr. Roentgenol., Aug., 1919, p. 385.

Case No. 4. D. M., now nine years of age, is a most instructive case. A brief résumé is as follows: When four years of age, the tonsils and adenoids were removed, with much improvement. This was in 1916, when routine examinations of paranasal disease in four-year-old children were not made in our clinic. The patient would unquestionably have been much better off if, in 1916, she had been examined, diagnosed and treated for the paranasal sinus disease, which was undoubtedly present. When seven years of age a diagnosis of bilateral sphenoiditis and posterior ethmoiditis was made. The diseased conditions were treated by operation, with marked improvement of the arthritis and general condition. The patient was discharged in December, 1919. In July, 1921, she returned, with a recurrence of the acute arthritis. The sphenoid and ethmoid regions were perfectly healed and clean. A careful examination showed pus in the left maxillary sinus. This sinus was drained, and in three weeks there was a most noticeable improvement. For six weeks before the patient came into the service she received the most careful medical treatment and vaccines in the pediatric service, without improvement of her acute trouble. The only thing that gave this little girl relief from her acute symptoms when she was six, and when she was nine, was the treatment of her paranasal sinuses.

Case No. 5. Mrs. S., aged forty-four, came complaining of right-sided headaches, which had begun at the age of six years. Also, frequent attacks of pain in right forehead and right eye. The headaches had always been of this type. In examining the paranasal sinuses, when a maxillary sinus was irrigated the patient immediately said that the pressure caused the typical headache. Eradication of a chronic maxillary sinus disease resulted in an immediate and permanent disappearance of the headache, which had persisted for thirty-eight years.

Therefore, the value of the X-ray to the eye, ear, nose and throat specialist will show in practically all cases the presence or absence of, the anatomy of, and the pathology of all the sinuses, if any be present. The identity of the pathology may or may not be conclusive. The routine X-ray examination and treatment of the pathological sinuses in children will in a large majority of cases obviate the necessity of the lesion becoming chronic in adult life. Practically every case of sinusitis in children will become chronic if not properly treated.

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2. Prentiss, H. J.: Roentgenological Interpretation of Accessory Sinus Variations. Am. Jour. Roentgen., IV, 1917, p. 390.

3. Prentiss, H. J.: Some Variations in the Sphenoidal Sinus as Found in the Anatomical Laboratory of S. U. I. Jour. Iowa St. Med. Soc., V, July 15, 1915, p. 263.

Cassette design.—The usual practice in cassette design is to make the cover rigid, whereas the thin aluminum face of the cassette cannot be made rigid, no matter how tightly it is stretched over the frame. With such a cassette the contact depends largely on the character of the padding on the cover. It would seem more logical to attempt to make a cassette cover that, under the pressure of the springs, would assume nearly the same form as the front face, and use a layer of felt or other padding sufficient to compensate for the small irregularities between the surfaces. For convenience in using the cassettes, the cover should preferably be hinged permanently to the cassette in a manner that allows for variation in the thicknesses of screens.

J. D. Camp, M.D.

Some Causes of Poor Contact between Intensifying Screens and Film. R. B. Wilsey. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 375.

POINTS TO BE CONSIDERED IN THE APPLICATION OF RADIUM

By WILLIAM H. CAMERON, M.D., PITTSBURGH, PENNSYLVANIA

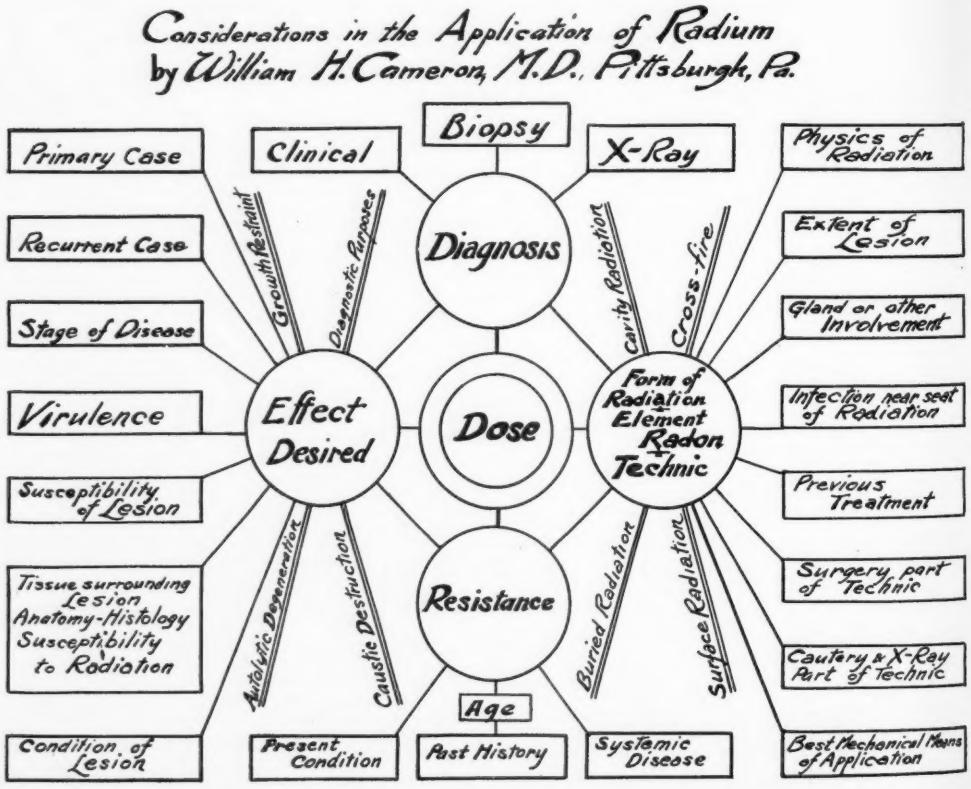
IN CONSIDERING the basic and the contributing factors that one must correlate in order to utilize the radiations from radium or radon to the best therapeutic advantage, it occurred to me that I might visualize, with some semblance of order, the various facts that I found assisted materially in the building up of what might be termed radiological judgment for the individual case.

I realize, of course, that actual experience is the best if not the only teacher; nevertheless, I feel that constant visualization of all the points charted (their relation to each other, etc.) has been of considerable help in arriving at the main issue—the dose.

For operators who have established a fixed standard (erythema dose, etc.) such a chart is, perhaps, of no value. My experience, however, teaches otherwise.

To attempt a complete explanation of all the points involved would require considerable time and space, a thing I shall not attempt here. My object in offering the chart at this time is, then, to bring about an open discussion from which I hope to further improve or discard the idea.

Personally, I believe it will assist the beginner, in that it will at least impress upon him the fact that the application of radium is an art requiring wide general information, together with special knowledge of the disease he intends to radiate.



APPARATUS FOR THE CALIBRATION OF X-RAY MACHINES

By ROY KEGERREIS, Section on Physics, Mayo Clinic, ROCHESTER, MINNESOTA

THE output of the average X-ray installation varies from time to time. It is accordingly necessary to make periodic tests in order to be able to specify intelligently the doses which are to be administered. A portable testing apparatus which may be taken from one machine to another is most desirable for this purpose. The appliances that are being sold are fragile and not readily used by the uninitiated, and in general require careful periodic checking up in order to insure any sort of reliable standardization. I have developed the principles which make possible the three forms of apparatus that are described here.

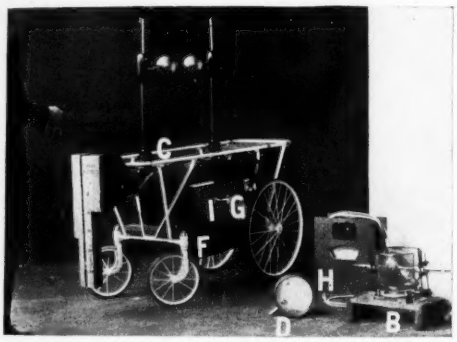


Fig. 1. Semi-portable apparatus for testing X-ray machines.

SEMI-PORTABLE TESTING APPARATUS

There is great need for cross-checking the individual machines of any one institution, especially if considerable treatment is carried out with no time available for a painstaking biologic check-up on each machine. A semi-portable outfit has been assembled for such use by mounting a sphere gap and ionization chamber on the running gear of a wheel stretcher (Fig. 1). The sphere gap has 12.5 cm. diameter spheres, and was originally provided with the conventional screw for making and unmaking the settings. It is a distinct advantage to eliminate the undesirable features of this screw motion and have a more easily read, uniform and enlarged scale with a quick return for the settings after the spark has passed. A cam was designed

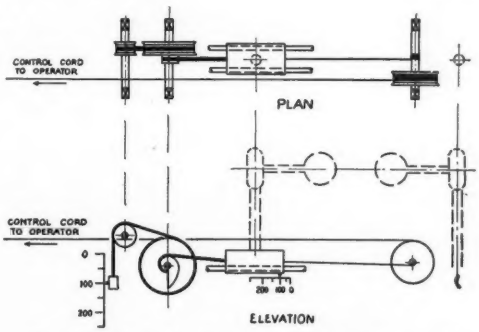


Fig. 2. Schematic diagram of sphere-gap control.

which would make the scale linear, and the quick return feature was incorporated in the design, as shown schematically in Figure 2. The weight on which the vertical scale pointer is fastened tends always to pull the sphere gap wide open. The cord which the operator holds is wound on a large pulley that is rigidly attached to a shaft around which the connection to the support of the movable sphere is wound. The operator thus has a delicate control on the setting of the sphere gap which, in operation, is gradually made smaller until the spark passes, after which the tension on the cord is released and the gap opened at once by the pull of the pointer weight. The connection between the support of the movable sphere and the cam, and that between the cam pulley and pointer weight, are made of steel tape, which insures an absolute correspondence in the ratio of the movements. By this arrangement the operator is far removed from high tension conductors, and yet is in a position to observe the scale readily while the setting of the sphere gap is being varied, as well as at the instant the spark passes. This plan might well be incorporated in most sphere-

gap installations; both the scale and control could be placed in the operator's booth.

The voltage which will spark across a given gap depends on the density of the air, which in turn is dependent on the barometric pressure and temperature. Mr. R. H. Marvin has recently published a correction chart for 25 cm. diameter spheres. His work has been followed in the construction of a similar chart for 12.5 cm. spheres, which is the size most commonly used in X-ray work (Fig. 3). The necessary correction factor is found by connecting the barometric pressure and temperature with a straight-edge and noting where it crosses the correction factor scale.

After the sphere-gap calibration of the machine has been taken, an X-ray tube (A) (Fig. 1) which is permanently mounted in its holder (B) is placed on top of the stationary base of the sphere gap (C). The tube is connected to the aerial through a milliammeter (D) which replaces one of the spark-gap series resistances. One standardized X-ray tube is used for all the tests of all the moderate voltage machines. This, of course, has the disadvantage that the generating outfit and the tube which is used with it in giving a treatment are not tested together. All the tubes are separately standardized against the institution's standard tube. This is found to involve less error than a combination test would, because of the trouble with the individual adjustment of target distance at each machine when making the test. The ionization current readings are then taken by means of a portable microammeter (E) which is con-

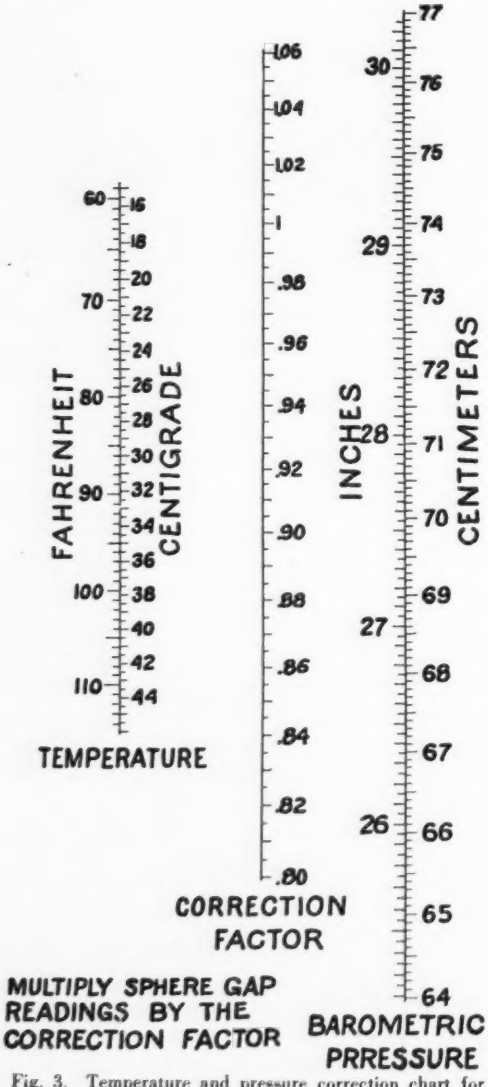


Fig. 3. Temperature and pressure correction chart for 12.5 cm. sphere gap.

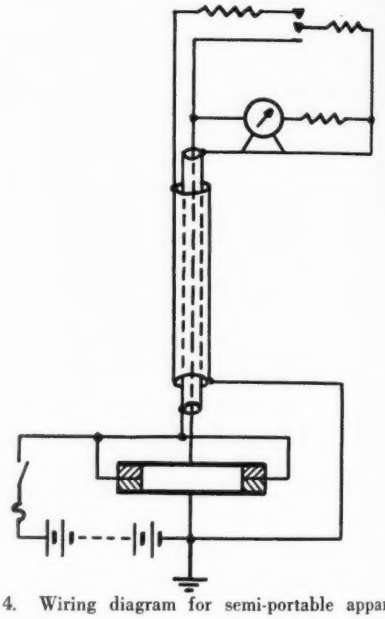


Fig. 4. Wiring diagram for semi-portable apparatus.

nected to the battery (F) and ionization chamber (G) through a single socket (I) and jack (H) and a thirty-foot-long triple conductor concentric cable. This is the only connection which must be made during the use of the apparatus. The microammeter is of an entirely different order of ruggedness than other types of the same sensitivity. It is necessary to have standardized conditions of voltage when using ionization chambers for intensity measurements. A push button is provided on the top of the microammeter case for making this test. Figure 4 shows the wiring diagram by which such a test is made possible (1). The other push button is for short-circuiting the meter to dampen the motion of the pointer while it is being moved about (not shown in Figure 4).

PORTABLE IONIZATION TESTING OUTFIT

A small and easily portable apparatus has been devised, which service men can carry from one installation to another, in order to check up the tube performance and output of installations as a whole (Fig. 5). The variation in tubes is widely discussed. It has been found that the more the Coolidge type of tube is used, and the more accurately they are tested, the smaller are the differences; there is only a slight variation among tubes.

The entire apparatus is self-contained; the ionization chamber is in the top part of the case while the lower part contains a microammeter with a switchboard type scale and the necessary batteries. There is a push button on the rear side for checking up the battery voltage, and a handle for varying the number of cells in the circuit. Only one range is provided in the microammeter, but distance, aperture or filter variations can be used to adapt it to any machine, no matter how great the output. The apparatus functions with either side up, thus making it possible to take measurements from above or below.

This one independent system of electrical circuits which is entirely self-contained within a single case, in connection with a sphere gap, enables thorough standardization of widely separated machines. The instrument has a ruggedness which is comparable to a portable voltmeter or ammeter. The chances are very great that, if its inherent calibration is disturbed in any way, through being moved about, it will be "way off," that is, the pointer will stick or be

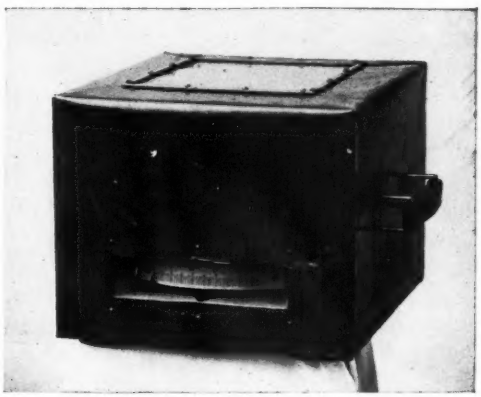


Fig. 5. Portable ionization testing outfit.

broken in some way. The check-up on the battery voltage serves the double purpose of testing the potential and making sure that the meter itself is working properly. The voltage of the battery never increases materially, so that any possible error is on the side of safety. A double check on the accuracy of the battery voltage and meter calibration may be made by measuring the battery voltage by means of a separate meter while the microammeter is also measuring it. This may be done by connecting a direct current voltmeter between the outer covering of the case and a high potential contact placed within the rubber handle of the voltage varying dial. The ionization takes place because of the geometric arrangement of the parts of the ionization chamber. They are capable of withstanding rough usage; for instance, the ionization chamber is tested before being placed in the case by being let fall to the

top of a work-bench, the distance of one foot, half a dozen times.

RADIUM MEASURING SET

The foregoing form of set-up has been adapted to the measurement of radium tubes by my associate, Mr. Halstead. Either bare tubes, tubes in applicators or tubes within the common lead protective carrying case may be measured directly. This is done by merely laying the tube of radium on top of the ionization chamber, holding down a push button and reading the deflection of a galvanometer by noting the location of a light spot. The push button connects a rectifying tube and smoothing-out condenser to the alternating current lighting circuit, as well as switches on the galvanometer scale lamp. The accuracy of this arrangement is not as high as those of the other sets of apparatus described here, but it is felt that the accuracy is well within the range demanded by this type of biologic therapeutics. Separate scales are provided for the different types of applicators.

SUMMARY

A specially designed mechanism has been incorporated with a sphere gap in order to make the scale greatly enlarged and linear, and to save time in making and unmaking the sphere gap adjustments. Ionization chambers have been developed and sensitive current measuring instruments with pointers have been adapted to measuring the intensities of ionizing rays. The output of a roentgen-ray tube is measured by means of a portable direct deflection instrument which eliminates the use of a stop watch.

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Leukemia.—Sixteen cases of leukemia are reported as to the effects of X-ray treatment on blood counts, basal metabolism and weight. While no attempt is made to refute the evidence that permanent cure is not to be expected, careful observation of the metabolism in connection with the counts and weight will help to establish more definitely how much treatment should be given and whether further treatment is indicated after prolonged remission.

Roentgen rays will not cure leukemia, but both the chronic forms respond to this treatment and life is prolonged. Patients need to be watched indefinitely. A slight rise in blood count or metabolism may indicate a recurrence. Patients may be over-treated.

First technic used was 10 in. distance, 50 mam., 8 in. gap, 1 mm. aluminum, 4 mm. leather, 1 cm. wood and 2 mm. bakelite as filter. Later the gap was increased to 9 inches and the time to 35 mam. Trunk was divided into six anterior and six posterior areas, a treatment usually covering three of these areas. In a few cases the spleen and sometimes the long bones were treated. Treatments at first were once or twice a week, reducing this as the count went down.

W. W. Watkins, M.D.

Blood Counts and Basal Metabolism of Leukemias under Roentgen-ray Treatment. Kenneth R. McAlpin and Bertram J. Sanger. Am. Jour. Med. Sci., Jan., 1924, p. 29.

MADELUNG'S DEFORMITY [1]

By LESTER LEVYN, M.D., F.A.C.P., BUFFALO, NEW YORK

THE recent occurrence in the writer's practice of two cases of spontaneous forward dislocation of the wrist joint, prompted him to review the literature on the subject. This task proved peculiarly interesting because at its conclusion the résumé brought to light the fact that practically all that had been written on the subject came from the pens of French, German and Italian authors.

Up to 1901, scarcely anything appeared in American literature with the exception of text-book references, which were only meager. In that year, however, Stetten wrote an illuminating article and reported the first case in America. In 1910, Stokes reported two cases. In March of the present year, Brown added the fourth case to the list and, to my knowledge, the two cases I wish to present, constitute the fifth and sixth in American literature.

In 1825, Bégin published a book in which a slight reference was made to the existence of such a disease. Most of the men who had written concerning this dislocation, even Madelung, gave Dupuytren the credit for the first description, but Dupuytren's article in 1834 was, as Stetten says, "based upon a quotation taken confessedly from Bégin. And second, this report concerns a class of cases which probably has nothing at all in common with the lesion that concerns us, except that the hand was displaced forwards." Stetten, after a careful examination of Dupuytren's rights, claims that he "finds them absolutely unsubstantiated."

In 1847, Smith described two cases and in the same year, A. Nélaton, one case. Malgaigne, in 1855, reported a typical case. In 1859, one was reported by Weber, and one in 1864 by Busch.

Jean, in 1875, was the first to describe an anatomical dissection. This dissection was done in a woman of 73 years, who had had the condition since childhood. There was a forward displacement of both wrists. The lower end of the radius was bowed forward and the lower end of the ulna was dislocated posteriorly.

In 1878, Madelung, before the seventh Congress of German Surgeons, presented a paper based upon the study of twelve cases and the postmortem examination of one. This was the first clinical presentation of the subluxation which has been known since as Madelung's Deformity. His conclusions, following the study of these cases, were described in the following manner: "The condition is a form of disturbance of growth in the joints as described by R. Volkmann and analogous to pes valgus, genu valgum and scoliosis. It develops spontaneously, never before thirteen and rarely after twenty-three, with pain and limitation in extension of the hand. Flexion may be increased, while the restriction of adduction and abduction varies. The affection is usually unilateral and twice as frequent in women as in men. The patients generally belong to the working classes and the deformity usually reaches its height in from one to two years. The main factor in its formation is the more powerful action of the flexors of the forearm due to overexertion. Continued hyperflexion stretches the extensor tendons and the posterior ligaments over the dorsum of the radial epiphysis, exerting a forward force and producing a volar bowing. Pressure of the carpus on the anterior edge of the lower extremity of the radius causes atrophy, while the release of pressure from the posterior edge permits of hypertrophic growth. The disease is one of the growth period, and requires as a predisposing factor, a primary weakness of the bones or a disturbance of nutrition such as that due to disuse."

Scattered throughout the literature one finds reports by Pooley in 1880, Félix in 1884, Duplay in 1885, Von Bergmann in 1888, Hoffa and Bode in 1891, Hoffa in 1905, and Guépin in 1892. In 1894, Mal-

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923.

fuson mentioned two cases in a mother and daughter, and Feré in 1896, a case of a mother and two daughters. Including the three cases reported this year, one by Brown and two by the writer, only sixty-seven authentic cases are on record.

Regarding the etiology, the various writers who have described the condition advanced definite theories. Most of the French authors are of the opinion that trauma plays an important rôle and also believe it to be an occupational disease, occurring in those vocations which engender a great amount of strain on the wrist. Others feel that trauma does not enter into the causation.

In 1892, Redard advanced the opinion that the deformity is produced by a disturbance of growth of the epiphyseal cartilage, that prolonged strain upon the wrist induced a hyperactivity of the cartilage which resulted in the production of bone hypertrophy and secondary subluxation.

Malfuson considered the deformity a result of disturbance of growth and function of both the radius and ulna, together with a tendency to rickets. Feré believed that development is interfered with in some manner and that heredity has some influence. Not infrequently there is a laxity of the ligaments due to an hereditary tendency which may be an etiological factor. Most of the cases occurred in young females.

The carpal bones, cartilages and epiphysis show the presence of dystrophy and atrophy and at times an hypertrophy of the dorsal side with an anterior curvature of the diaphysis of the radius.

In spite of the fact that most of the French authors, including Madelung himself, have felt that certain occupations were factors in the production of the deformity, no importance can be attached to those beliefs when one considers that the majority of the cases observed were in young girls. There has been nothing to substantiate the theories that the deformity is produced by rickets, osteitis fibrosa, osteo-porosis and osteo-genesis imperfecta.

The deformity, silver-fork in type, has a spontaneous onset and a gradual development. In some cases pain is present, while in others there is an absence of pain. In those cases in which pain was a symptom, it disappeared after the deformity was at its height, which generally occurred in two to three years, after which the chief symptomatology is fatigue upon even slight exertion and a sensation of weakness. Motion is generally restricted, particularly that which opposes the direction of the deformity, namely, extension in the anterior variety of the subluxation, and flexion in the posterior type, and abduction in both.

The end of the ulna may be forced back in position by strong compression, but the dislocation immediately returns when the pressure is released. The deformity of the radius, on the other hand, cannot be reduced by any manipulation.

The greatest changes occur in the radius, which is generally seen to be markedly bowed. This bowing was seen in fifty of the cases. In seven, the bowing was present in the entire bone; in one, the lower two-thirds; in three, the lower half; in five, the lower third, and in two, the lower fourth.

While the bowing is confined chiefly to the lower extremity of the bone its greatest intensity is in the region of the epiphyseal line, so that the bending is chiefly of the epiphysis itself. The deformity, too, may be the result of a broad, irregular epiphyseal cartilage, accompanied by a rotation of the entire epiphysis. In some instances both the epiphysis and diaphysis are involved in the curvature.

The postmortem study of the one case described in Madelung's original communication was performed upon the body of a young woman. The arm was prepared and a longitudinal section made in two places, one through the center of the os magnum and its articulation with the semilunar. The dissection divided the end of the radius so near its ulnar border that part of the incisura semi-lunaris was visible. The other section divided the lower part of

the ulna equally into two parts and passed through the cuneiform, pisiform and unsiform bones. It was thus seen that the carpus at its radial side was displaced forward approximately one-half inch, and, also, one-half inch upward by the absorption of the anterior half of the lower end of the radius, while the posterior half projected over the dorsum of the wrist.

Fig. 1. CASE 1. Dorso-ventral position.

Fig. 2. CASE 1. Radio-ulnar position.

The radius was seen to be shortened in twenty instances. "The epiphyseal ends of the bones are irregular, excurvated and not completely developed. They present the appearance of having been impeded in the completion of the edges and cartilages of the epiphysis. The end of the bone is not as large as normal. It is club-shaped and the processes will not hold the carpal bones in place on the volar side. The same is true of both ulna and radius. The cartilages between the carpal bones and the epiphyseal cartilages are imperfect, ossified in places, irregular in thickness, and wanting in other points. The volar side in general presents the appearance of a dystrophy (Franke and Poulsen). They also often present hypertrophy of the dorsal edge." (Weber, Busch, Madelung, Schulze, Bennecke, Franke.)

The results of treatment have not been particularly encouraging. The various orthopedic appliances have not accomplished noticeable improvement in maintaining reduction, because of the change in the shape of the bone. If pain is present, it disappears when the deformity reaches its height, prior to which limitation of use will alleviate any pain. Operations such as tenotomy or resection of the ulna are unjustifiable because function is not sufficiently interfered with to warrant such procedure, and for cosmetic purposes operation offers no certain results.

CASE HISTORIES

Case 1. Mother, Mrs. H., age 56, high social status. Slight bilateral deformity first noted at age of twelve which reached its maximum in two years, since which time it has been of the typical "silver-fork" variety. No history of injury, negative as to rickets, negative Wassermann. No spinal deformity. No deviation from the normal in other bones. Ancestors, to patient's knowledge, free of similar deformity. At no time was pain present. Wrists fatigue more easily than normal. Extension limited and flexion increased. No treatment was ever instituted. X-ray shows shortening of radius and ulna, with slight bowing of both. Slight backward displacement of lower articular portion of radius and pronounced backward dislocation of ulna. Excurvated, wedge-shaped appearance of articular surfaces of radius and ulna.

Case 2. Daughter, age 18, bilateral deformity noted while playing piano at age of

twelve, similar to that of mother. Reached its maximum at the fourteenth year, since which time "silver-fork" deformity has persisted. No history of trauma, no rickets, negative Wassermann, no other skeletal deviation from the normal. There is no pain, nor was any present before the deformity developed. Slight exertion produces fatigue and, as in the case of the mother, extension is limited and flexion increased.

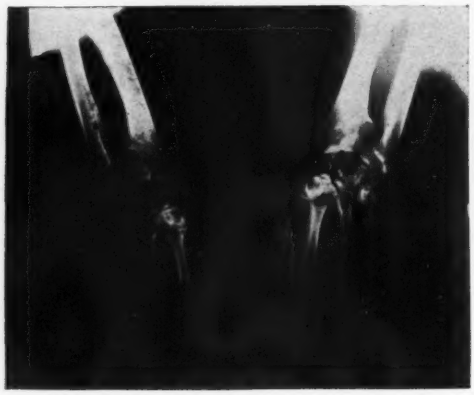

Fig. 3. Case 2. Dorso-ventral position.

Fig. 4. Case 2. Radio-ulnar position.

Roentgenograms show the bowing to be not as marked as in the first case. The excurvation and wedge-shaped surfaces are similar in both. This patient is a student at Vassar College and in the fall of the present year was advised to consult Dr. Walter Timme, of New York City, which she did. Dr. Timme instituted a course of glandular therapy, hypodermatically administering a combination of thyroid, pituitary (especially the anterior lobe), and antuitrin. Upon examination (September 20, 1923) the length measurements were as follows: olecranon to tip of ulna, 19½ centimeters; acromion to tip of ulna, 42¼ centimeters. Examination November 17, 1923: olecranon to tip of ulna, 20½ centimeters; acromion to tip of ulna, 44 7-10 centimeters, showing an increase in the length measurement of respectively 1 centimeter and 2 9-20 centimeters. No change in the deformity was apparent.

I am indebted to Dr. Julius Ullman, of Buffalo, for the opportunity of studying these cases.

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AN IMPROVED RADIOGRAPHIC TECHNIC FOR CHESTS

The Use of a Reducing Reading Lens in Viewing the Plates

By E. B. KNERR, M.D., KANSAS CITY

In making teleradiograms for heart measurements we noticed that the lung details in such chest plates were markedly improved, and therefore, of late, we have been making practically all our vertical chest plates at a target-to-plate distance of seven feet. Superspeed films with double intensifying screens at an exposure of one-half second to three seconds, depending on the age and size of the patient, and with a setting of the radiator tube at 5-inch gap and 30 milliamperes, give radiograms of lung conditions of most beautiful and minute details. Tubercular clouds, neoplastic metastases, enlarged thymus, etc., stand out in clear exhibit.

In this connection we would call attention to the great advantage a 4-inch negative (reducing) reading glass affords in viewing the larger plates of all subjects, but especially those of lungs, kidneys, gall bladders and soft tissues in general. Such a glass reduces the image of large plates viewed through it at a distance of five or six feet, to dimensions of the whole field easily grasped by the eye at once. The high lights and contrasts are much accentuated, bringing out faint tumor, gall bladder, kidney, lung and other densities. In fact, the impression of the view is almost stereoscopic in effect.

PULMONARY FIBROSIS

By KENNETH S. DAVIS, M.D., Fellow in Roentgenology, The Mayo Foundation, ROCHESTER, MINNESOTA

PULMONARY fibrosis is not a primary disease, but the result of a previous pulmonary infection or irritation. It is of interest to the roentgenologist because of the similar appearance in the roentgenogram of fibrotic lesions that are the end-result of many different processes. Often the fibrotic changes seen in the roentgenogram are the only changes demonstrable, the primary lesions having disappeared. In the classification of fibrosis, most writers, as a matter of convenience, recognize two general types, local and massive. The massive type is subdivided into tuberculous and non-tuberculous types. However, from the roentgenologist's viewpoint, a classification based on the etiology is probably more practical. In such a classification two general subdivisions can be made: fibrosis due to an infection, and fibrosis due to irritation of the lung, or of a mechanical nature (Table 1). These may be further subdivided into local and massive types, depending on the degree of involvement. Thus the causes of fibrosis may be said to include every disease, acute or chronic, to which the lung is subject, the chronicity of the primary affection having a great deal to do with the process.

Before the advent of the roentgen ray, fibrosis was regarded as an extremely rare condition; for example, in the Guy's Hospital reports, in a total of 21,317 necropsies performed in fifty years (1857 to 1906), there were only forty-six cases of pulmonary fibrosis (2). This is due to the fact that the pathologists were describing only the massive type of fibrosis, a condition which still remains as rare as the reports indicate.

TABLE 1

CLASSIFICATION OF FIBROSIS

1. Fibrosis due to infection
   - Tuberculosis
   - Pleurisy or empyema
   - Pneumonia (either lobar or bronchopneumonia)
   - Abscess of the lung
   - Syphilis
   - Infarcts
   - Mycotic infections of the lung
2. Fibrosis due to irritation of the lung, or of mechanical nature
   - Pneumonokoniosis
     - Anthracosis
     - Siderosis
     - Silicosis
   - Cardiac pneumofibrosis
   - Fibrosis following occlusion of a bronchus by mediastinal tumor, aneurysm, and so forth (an extremely rare condition)
   - Following intensive X-ray treatment directed to the chest.

MORBID ANATOMY

Fibrosis of the lung presents an extremely variable appearance, depending, first, on the causative factor, second, on the degree of involvement, and third, on its starting point, which may be the connective tissue around the bronchi and blood vessels, the interlobular septa, the alveolar walls, or the subserous areolar tissue of the pleura. When the process has been one of long standing, any one or all of these structures may become involved, and any trace of the original location be obliterated (17).

In this connection it might be well to review briefly the distribution of connective tissue in the normal lung, in order to obtain a more accurate conception of the abnormal distribution of fibrous tissue and its starting points (16), (21). First of all there is a general sheet of connective tissue which surrounds and invests the cartilages of the trachea and bronchi. This begins just below the larynx and continues to the terminal bronchioles, becoming thinner by degrees and changing into areolar tissue. The sheet does not end with the cartilages, but continues on around the tube, running

transversely between the ends of the cartilages to make up the posterior flattened wall of the trachea and bronchi. The blood vessels and nerves of the lungs which accompany the bronchial tubes are imbedded in this sheet. Outside of the bronchial tree, connective tissue is found to be the chief constituent of the alveolar walls or interalveolar septa. It consists of delicate fibrils which are supported and strengthened by scattered coiled elastic fibers. These fibers are especially numerous near the orifice of the alveolus. Connective tissue is also found scattered throughout the lung in the form of sheaths uniting and separating the various lobules and lobes. The amount of connective tissue varies, there being more between the larger, and less between the smaller lobules. In the subserous areolar tissue of the pleura, there are large numbers of elastic fibers which, apparently, are continuous with the areolar tissue in the lung. Thus, in the fibrosis beginning at the root of the lung, the spread is along the bronchial tree, whereas in the fibrosis beginning in the parenchyma of the lung, the spread is by way of the alveolar walls, or interlobular sheaths. Finally in the fibrosis following pleural involvement, the most common route of invasion is by way of the interlobular sheaths, and rather characteristic pathologic changes are produced. It is generally agreed that massive fibrosis is unilateral, whereas the types recognized in the roentgenogram may be either unilateral or bilateral. The lung is usually reduced in size, which of course varies with the degree and origin of the fibrosis. When only one part of the lung is involved, the remainder shows compensatory emphysema.

The involved part of the lung is firmer than normal, and on sectioning, cuts with increased resistance (1), (2), (7). The cut surfaces present a varied picture; in some cases the tissue which appears white and dense, like gristle, is distributed in broad bands, with narrower bands branching out from the main ones; in other cases the lung tissue is permeated by a fine fibrous network. As a rule, the fibrous tissue is most abundant at the root of the lung, with radiating bands extending toward the periphery. In the extreme grades of fibrosis, the involved area may be reduced to a mass of fibrocartilaginous tissue in which the bronchi are practically all dilated.

Occasionally there is a pleural thickening associated with pulmonary fibrosis, and, conversely, there may be a fibrosis of the lung associated with a thickened pleura. In the latter type the pleural changes predominate, so that at times the entire pleural cavity becomes obliterated. In this type of fibrosis the pleural changes undoubtedly mask the lung findings in the roentgenogram, so that the correct diagnosis cannot be made.

The bronchi are frequently dilated and their walls thickened. At times there is a definite cavity formation, due either to dilated bronchi, or to a necrotic process. According to Norris and Landis, in about 80 per cent of the cases of fibrosis the bronchi are dilated; on the other hand, the bronchi are rarely dilated without associated interstitial changes in the pulmonary tissue.

The clinical picture of fibrosis is not at all characteristic. As a rule, the patient is past middle age, with a history of longstanding cough, expectoration, bloody sputum, and dyspnea on exertion. The temperature is either normal or slightly above. The outstanding feature is that, in spite of the long duration of symptoms, the general health is but little impaired.

X-ray findings. Neither is the roentgenogram characteristic, but varies according to the etiology, the origin and extent of the fibrosis, the dilatation of the bronchi, and the pleural changes. The earliest changes of fibrosis are most often seen at the hilus, and as the process progresses, small fibrotic bands extend from the hilus along the bronchial tree into the fields of the lung, thus accentuating the markings and increasing the size and density of the hilus shadow. This is true with but two exceptions: the fibrosis due to tuberculosis, and the fibrosis of pleurogenic origin. In the former the

process begins in the apex, whereas in the latter it usually begins at the periphery of the lung and is masked by the pleural changes. As the process becomes more extensive, definite fibrotic bands can be made out, extending from the hilus to the periphery. Usually this infiltration spreads first to the lower lobes, involving the upper lobes later. In cases in which the fibrosis is localized, there is apt to be retraction of the lung, owing to the pull of the fibrous tissue attached to the thickened pleura. Finally, in massive fibrosis, which is almost always unilateral, the entire side may appear as a dense homogeneous shadow, the heart and other mediastinal structures being pulled over to the affected side. There are several factors which may possibly aid in the differentiation of massive fibrosis from other lesions. If the disease is of long standing, there is very apt to be a collapse of the chest wall, due to the retraction of the fibrous tissue, which may be associated with a compensatory scoliosis of the spine. In most cases there is an associated bronchiectasis, which at times can be diagnosed in the roentgenogram, and there is usually a compensatory emphysema of the uninvolved side, the ribs being more widely separated than normal. Moreover, in spite of the extensive involvement, as seen in the roentgenogram, the patient's general health is fairly good.

FIBROSIS DUE TO TUBERCULOSIS

Tuberculosis is probably the most important single factor in the production of pulmonary fibrosis, owing to the fact that the arrest of a tuberculous process is accompanied by the formation of fibrous tissue around the lesions. In certain cases the formation of fibrous tissue far exceeds what is needed, and gives rise to true pulmonary fibrosis. Norris and Landis and Elsner recognize two forms of fibrous phthisis: tuberculofibrous disease, a condition in which the lesion is primarily tuberculous, but in which there is an overgrowth of connective tissue; and fibrotuberculous disease, a condition which is primarily a fibrosis, inflammatory or irritative in origin, which later becomes tuberculous. The first type usually is primary in the apices or upper lobes, the fibrotic process extending downward from its primary source. The pleura is rarely involved in this type of fibrosis unless there has been effusion or tuberculous empyema. The heart is not so likely to be pulled to the affected side as in the inflammatory types. If cavities are present, they are surrounded by a thick dense wall of fibrous tissue, usually involving not only the surrounding pulmonary tissue, but the pleura as well. They are ordinarily located in the upper lobes or apices. In early tuberculous fibrosis the hilus is not so likely to be thickened, as it is in the other types.

FIBROSIS DUE TO PNEUMONOKONIOSIS

Pneumonokoniosis is probably second in importance in the production of pulmonary fibrosis. The earliest changes observed are characterized by an increase in size and density of the hilus shadow, together with an increase in prominence of all the lung markings, and cannot be differentiated in the roentgenogram from the early fibrosis of other types. As a rule the increase in the thickness of the bronchial tree is fairly uniform, and there is an undue prominence of the finer linear markings. Jarvis believes the extension of the lesion is not from the hilus outward, but rather that the lesions are peripheral, and the increase in hilus density and size is an index to the peripheral severity. He was led to these deductions by observing the difference in size of the hilus in stone cutters, who were forced to quit work temporarily, on account of injuries. The hilus decreased in size during the enforced vacation, and increased to its original size soon after the patient's return to work.

The intermediate stage of pneumonokoniosis is characterized in the roentgenogram by numerous small fibrotic areas scattered throughout the fields of the lung, producing a characteristic mottling, together with hilus thickening. This stage can be

clearly differentiated in the roentgenogram. Its onset varies from a few months to many years, according to the amount and type of dust inhaled, the individual's resistance, his manner of breathing, and other factors (Fig. 1).

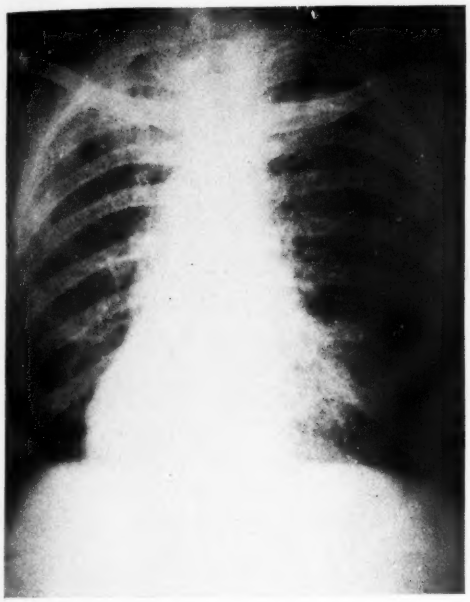

Fig. 1 (A376363). Hilus thickening and the miliary infiltration of the lung that characterizes the intermediate stage of pneumonokoniosis.

The only means of distinguishing the third stage of pneumonokoniosis from other types of extensive fibrosis is by the fact that it is bilateral, whereas the ordinary inflammatory type is usually unilateral. In the roentgenogram there are seen large coarse patches of increased density scattered throughout the lung fields, but usually of the greatest density in the upper lobes below the apices. These are probably due to a conglomeration of the finer mottled areas occurring in the second stage. The other findings in the roentgenogram are those of a diffuse fibrosis in which there can be seen dense fibrous bands extending in all directions, usually running to the periphery, together with pleural adhesions, with or without a retraction of the diaphragm (Fig. 2). As with the other types of fibrosis, bron-

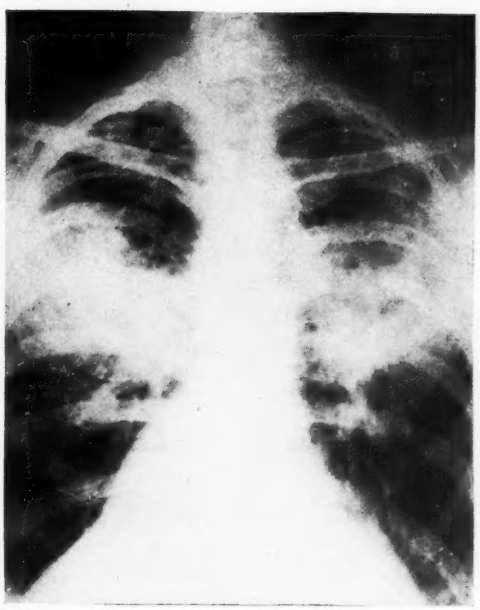

Fig. 2 (A375440). Marked bilateral fibrosis of the lung in a copper miner. There is a very characteristic distribution of the fibrous tissue.

chiectasis is a common accompaniment. In this stage of pneumonokoniosis, tuberculosis occurs with sufficient frequency to warrant a careful scanning of the roentgenograms and repeated sputum examinations before it is excluded. It is always well in border-line roentgenograms to inquire into the patient's occupation in order to rule out pneumonokoniosis.

FIBROSIS DUE TO SYPHILIS

Certain types of pulmonary syphilis probably furnish the best examples of a true fibrosis, owing to the low-grade inflammatory reaction which sets in following the lodgment of spirochetes in the lung. This results in an extensive cellular infiltration, together with an overgrowth of connective tissue in the alveolar walls, and proliferation and desquamation of the alveolar epithelium. The walls become greatly thickened, as do the blood vessels, until gradually the whole area is converted into dense fibrous tissue. The indurative changes usually originate at the hilus of the lung,

and extend outward along the bronchi and blood vessels, but may originate in the subserous areolar tissue of the pleura, or the connective tissue in the interlobular sheaths. The process is unilateral and usually limited to only a portion of one lobe; if more than one lobe is involved, it is in the part of the lobes that adjoin the root of the lung.

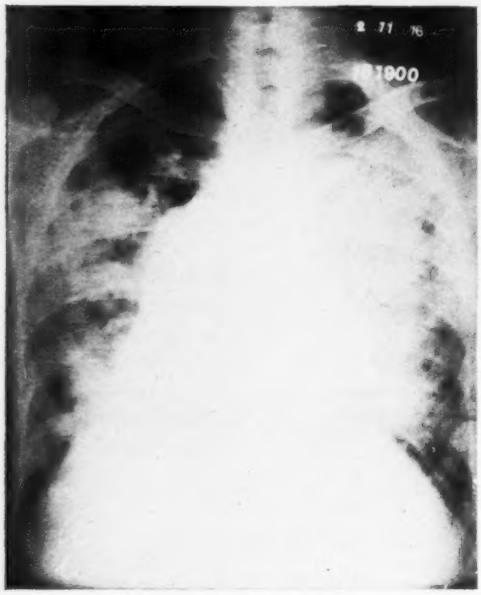

Fig. 3 (A151900). Marked fibrosis of the lung in a case of acquired syphilis. At necropsy no cause other than syphilis could be found for the fibrosis. Spirochetes were not demonstrated in the tissue of the lung.

Syphilis of the lung undoubtedly co-exists with other diseases, which mask to a certain extent its roentgenographic characteristics. It is difficult to determine the percentage of fibrosis, of syphilitic origin.

Watkins asserts that syphilis of the lung occurs much more frequently than is generally believed, especially in connection with tuberculosis; each infection may produce its own lesions, or on the other hand, the two diseases may occur as a true symbiosis. His observations have not been substantiated by other observers, and Carrera, in his review of the literature on pulmonary syphilis, has commented on the extreme rarity with which this condition is found at necropsy. At the Clinic only one case of fibrosis of the lung due to syphilis has been observed (Fig. 3).

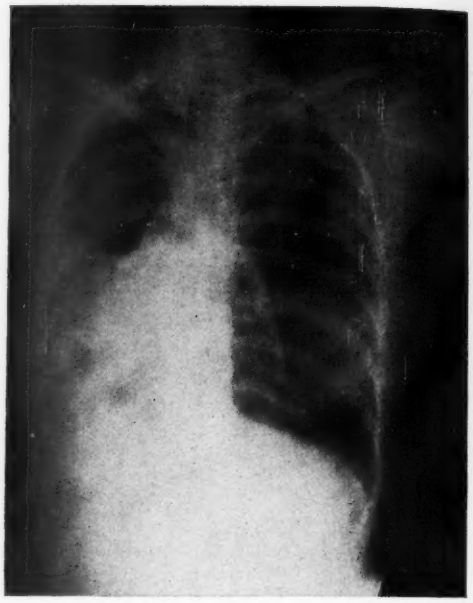

Fig. 4 (A403891). Intrathoracic changes following intensive roentgen therapy directed to the thorax. The lesion has a definite fibrotic appearance in the roentgenogram.

CARDIAC PNEUMOFIBROSIS

The cardiac pneumofibrosis described by Holmes and Dann cannot be distinguished from the early changes observed in the other varieties of fibrosis, except by the fact that the condition is always bilateral, and the pulmonary findings are always accompanied by an abnormal appearance in the heart's shadow. The condition is described in Delafield and Prudden as a brown induration, in which the lung tissue shows an overgrowth of the connective tissue normally present, and is of a red-brown color, due to the deposit of hemoglobin. The capillaries in the alveolar walls are greatly dilated and tortuous, so that they project in loops into the alveolar cavities. The whole process is, of course, due to chronic passive congestion in cases of decompensation of the heart.

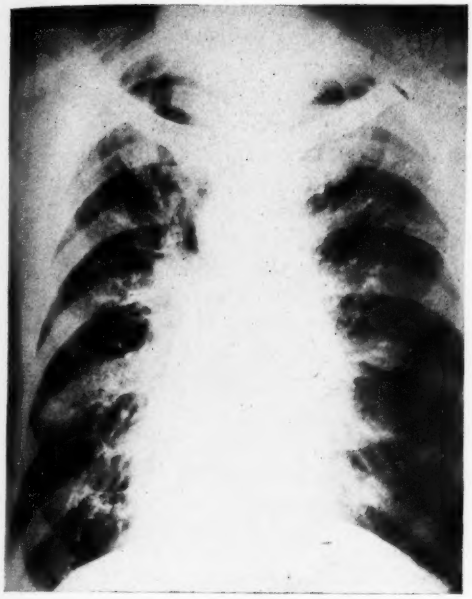

Fig. 5 (A448444). Marked bilateral fibrosis of the lung following chronic bronchitis.

FIBROSIS FOLLOWING X-RAY TREATMENT

Tyler and Blackman, Groover and Merritt, Hines, and others have reported cases in which patients receiving intensive doses of roentgen rays directed to the chest have developed symptoms referable to the treated side, such as pleuritic pain, dry hacking cough, dyspnea, elevation of temperature, and slight cyanosis. Roentgenograms of the chest taken at this time show a definite area of infiltration in the lung, with or without pleuritic involvement. In the cases observed by Tyler the pleural changes were apparently primary, but other observers have noted the primary changes in the lung. In either case, the condition later on produces a fairly definite picture of fibrosis in the roentgenogram, with thickened pleura, with or without adherent diaphragmatic pleura, and with a definite thickening of the hilus, from which fibrotic bands extend out into the involved area. The mediastinal structures are pulled toward the affected side, and there is a definite restriction of expansion observed in the fluoroscope. Later the lung may become retracted in all but those areas in which pleuritic adhesions have taken place. After recovery from the initial symptoms, the patient's general health remains good except for a dry cough and slight dyspnea on exertion. In all the cases reported, the condition was unilateral.

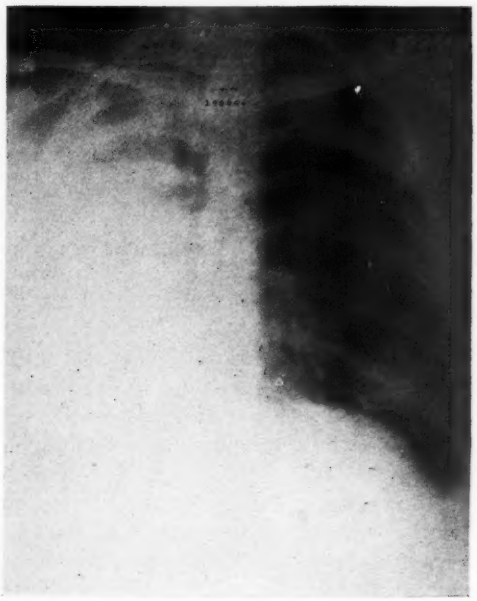

Fig. 6 (A298646). Difficulties encountered in differentiating massive fibrosis, clinically diagnosed as fibrous tuberculosis; tuberculosis bacilli were found in the sputum, and repeated exploratory punctures were negative for fluid. The clinician said that the needle met with resistance suggestive of thickened pleura. The retraction of mediastinal structures may be due either to pulmonary or pleural involvement.

The lesion is still a matter of uncertainty, since in none of the biopsies reported has there been conclusive evidence that a fibrosis was produced by the roentgen ray (Fig. 4).

DIFFERENTIAL DIAGNOSIS

Probably the lesion most closely simulating fibrosis is that of infiltrative carcinoma, either primary or secondary. According to McMahon and Carman, the roentgenographic picture of the infiltrative type of primary carcinoma of the lung shows one or more areas of increased den-

sity along the roots of the larger bronchi. The shadows may be homogeneous or mottled, and are wedge-shaped with the apex pointing toward the hilus. There may be either unilateral or bilateral involvement. The borders of the growth are infiltrative, but do not reach the periphery of the lung until late in the course of the disease, so that small areas of air-filled lung tissue can be seen between the tumor and the chest wall. A striking feature in all types and cases is the absence of any increase in mediastinal density. The most common site of this type of lesion is one of the lower lobes.

Pfahler describes primary malignancy as an infiltrating mass around the root of a lung extending outward along the bronchial tree, frequently in an upward direction, which may aid in distinguishing it from the inflammatory infiltrations around the root of the lung, which tend to spread downward. In its early stages malignancy resembles the inflammatory thickening which is likely to occur in this region. According to Holmes and Ruggles, the infiltrative type of primary malignancy is almost always unilateral, is primary in a bronchus, and invades the lung along the bronchial ramifications. The tumor may extend to the root of the lung and form large masses at the hilum. It is worthy of note that the heart and other mediastinal structures are displaced to the opposite side, in contradistinction to cases of fibrosis in which the mediastinal structures are pulled toward the affected side. Also in malignancy of the lung there is frequently an involvement of the pleura with effusion, and when the chest is tapped the exudate is bloody. The course of the disease is short and the symptoms progressive, especially the loss in weight and strength, whereas in pulmonary fibrosis the general health remains good for years.

In massive fibrosis, as has already been stated, a differential diagnosis is rarely possible from the roentgenogram alone. Empyema, adhesive plastic pleuritis, pneumonia with pleural involvement may all have a similar appearance in the roentgenogram, even to the collapse of the involved side and the retraction of the mediastinal structures. The relative infrequency with which this type of fibrosis occurs (46 in 21,000 postmortems) makes the diagnosis of little significance. As regards the differential diagnosis between pulmonary fibrosis and bronchiectasis, it is not a question of distinguishing them, but of determining whether the two conditions are associated. Both are due to the same causes. In about 80 per cent of the cases of extensive fibrosis, the bronchi are dilated, and on the other hand the bronchi are rarely dilated without associated interstitial changes in the pulmonary tissue (Figs. 5 and 6).

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Chest diseases of infants and young children.—The X-ray examination of the chest of the infant and young child is beset with many difficulties not encountered in the adult. The anatomical difficulties are mainly the preponderance of the mediastinal shadow, the comparatively small area of lung, and the closeness of the ribs. The technical difficulties are due to the inability to have the co-operation of the patient. The necessity for correlating the clinical data and X-ray findings is even more imperative in children than in adults. The conditions discussed in this paper are acute respiratory infections, tuberculosis and thymic enlargement.

The acute respiratory infections, including the acute infectious fevers, may decidedly alter the normal X-ray appearance of the child's chest, by visible enlargement of the lymph nodes, by intensifying the hilum and trunk shadows or by making more prominent the almost structureless shadow of the lung parenchyma. The proper interpretation of these shadows is a most difficult problem and the percentage of error is likely to be great.

In puerile tuberculosis, there are lacking the characteristic roentgenologic features of the adult, the typical shadow in the child being an increased density of hilum shadow with the radiating trunk shadows much accentuated. This appearance may differ little from an acute infection, syphilis or passive congestion, and a positive etiologic diagnosis cannot safely be made from the X-ray appearance. A negative X-ray film is good evidence against the presence of tuberculosis.

Chronic non-tuberculous pneumonia, when it presents a typical picture, shows unusual prominence of hilum and trunk shadows, the latter being especially in evidence in the bases. The appearance resembles a beginning or resolving pneumonia or the early stage of abscess.

The diagnosis of thymic enlargement is not free from possible error. The thymus may not show visible enlargement of its shadow and still be producing symptoms. Enlargement may be present during expiration and not show on films taken during inspiration. Radiation treatment is a specific for this lesion, if present.

W. W. Watkins, M.D.

X-ray Studies of the Chest in Infants and Children. Henry K. Pancoast. Atlantic Med. Jour., Nov., 1923, p. 70.

A COMPACT X-RAY TREATMENT UNIT

By EDWARD W. ROWE, B.Sc., M.D., Lincoln, Nebraska

THIS subject and the illustrations are presented because of the interest aroused in the installation of newer equipment for the administration of short wave-length therapy. The continued use of superficial and intermediate therapy is in no wise changed. The newer methods have not altogether displaced the older methods of treating pathological conditions. It is often necessary to combine, for practical purposes, the higher voltage equipment with the older machines. In many laboratories there is no need for this economy. The new short wave-length equipment can simply be added to the existing department. However, the unit here presented combines the two different types of treatment equipment in small and compact space. A great variety of cases can be seen in the practice of general roentgenology.

The chief factors here shown are:

1. A central control station which is safe for the operator.

2. A central compartment for the transformer and such other equipment as is unsafe, unsightly, and makes a great noise.

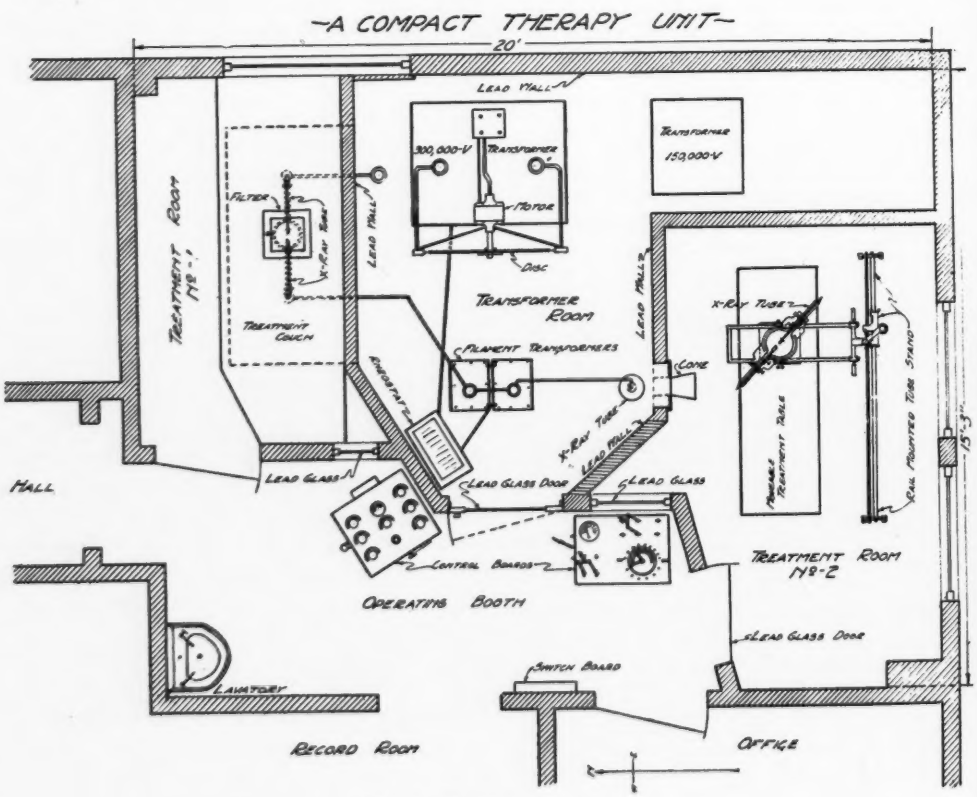


Fig. 1. Compact therapy unit.

Fig. 2. Operating booth.

3. So far as the short wave-length equipment is concerned, all danger of the patient or operator coming in contact with the high-tension current is removed.

4. The factors controlling dosage are more rigidly standardized.

5. The patient is removed as far as possible from all psychologic disturbances which might be caused by the fear of strange sights, unpleasant noise, and danger.

6. The flexibility of the equipment facilitates economy in space and in personnel, in handling a great variety of patients.

The overhead in Room No. 2 might be connected with the larger transformer (it is here connected only with the 140 kilovolt

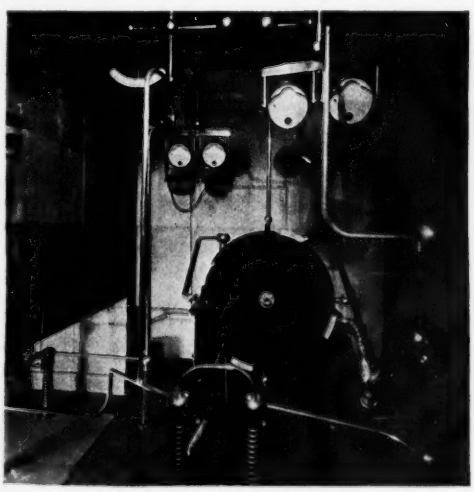


Fig. 3. Transformer room. The 140 kilovolt machine barely shows in the right-hand corner.

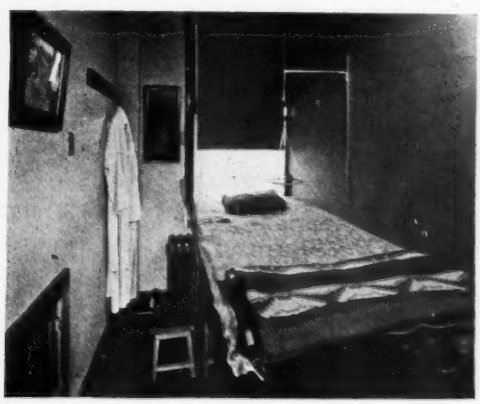


Fig. 4. Treatment Room No. 1. Couch; tube underneath. The apparatus hanging from the wall is used to find the area for treatment. Diaphragm with filters hidden beneath the mattress. This mattress absorbs 7 per cent of the ray.

transformer), thus increasing still further the flexibility of equipment and even allowing the treatment of two areas at one time.

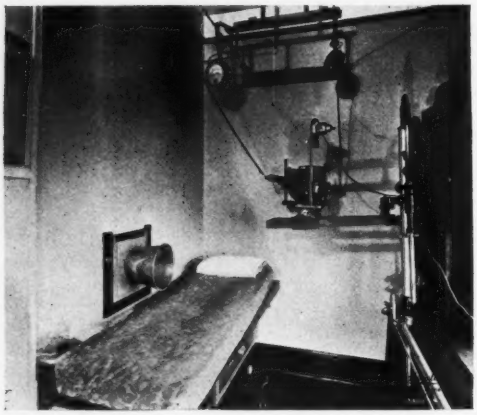


Fig. 5. Treatment Room No. 2. It is used for short wave-length therapy through the diaphragm in the wall. The table may be raised or lowered. Also, this room may be used for superficial and intermediate therapy. In that case, the tube stand, mounted on a rail, and the overhead will be used. Otherwise, they are pushed out of place.

CHECK FRACTURES

By FREDERICK E. DIEMER, M.D., PORTLAND, OREGON

Before the advent of radiography many cases of "strain" and "sprain" of parts went unrecognized as fractures. After roentgenology became a distinct specialty in medicine and surgery many cases of continued complaint and lameness perplexed the surgeon and roentgenologist. Since we have been using the 5-10 radiator type tube a goodly number of these cases have been explained.

The term "check" is suggested because of the behavior of ice after settling. The minute gross continuity is not disturbed and the ice covers the waters with its function maintained almost perfectly. Regardless of the non-break in continuity (which the text-books insist is the paramount sign of fracture), the ice is "broken" even though its function is maintained. Comparing, the bone examined by means of the very fine focus tube shows no gross break in continuity. We do see, however, a slight disparity of minute bone detail with an indefinite, quite indistinct, line of abnormality. We class this as evidence of check fracture with either extremely slight impaction on one aspect with the same degree of slight separation on the other aspect, or with extremely slight impaction on all sides.

This fracture occurs principally in bones without weight- or pull-bearing function. It is most common in the fibula at either of its ends, its lower especially. The skull is quite commonly the site of this fracture, the tables being undoubtedly fractured with no appreciable break in continuity. Here fracture occurs very often by "contrecoup." The ribs are next most frequently involved, while the head of the radius is next. It also occurs often in bones possessing weight- and pull-functions, the tibia and the lower end of the radius.

Check fractures are more often caused by indirect violence: Turn of ankle, contrecoup, fall on extended arm (fracture head of the radius), blow on chest producing fractured ribs posteriorly, etc.

"Green stick" fractures can be differentiated because they present a break in continuity.

The technic is not mentioned, but in general we will state that the difference in bone detail obtained by ordinary methods and that obtained by means of the very fine focus tube with perfect exposure make the differentiation between check fracture and "no bony injury."

Aneurysm of the aorta. — The differential diagnosis of sacciform aneurysm and cylindrical dilatation is quite easily made, as in the sacciform, a pulsating definite sac is seen. Clotting and organization within a sac frequently occurs, with resultant loss of pulsation. Pulsation of a group of glands, by pressure transmitted from the aorta, should be differentiated. In cases in which there is cylindrical dilatation the thoracic aorta can be seen throughout its entire course. The author has never been able to recognize an aneurysm below the diaphragm, and the presence of calcified plaques cannot be depended on for such a diagnosis.

J. D. CAMP, M.D.

The Roentgen Diagnosis of Aneurysm of the Aorta. E. C. Samuel. Am. Jour. Roentgenol. and Rad. Ther., XI, April, 1924, p. 361.

CASE REPORTS AND NEW DEVICES

REPORT OF CASE OF MYXOMA OF THE LUNG

By CHARLES G. SUTHERLAND, M.B. (Tor.),
Associate in Roentgenology, Mayo Clinic,
ROCHESTER, MINNESOTA

Case A168512. A woman, aged forty-one years, was admitted to the Clinic August 5, 1916. She had had influenza thirteen years before, followed by soreness and often dull pain through the upper right lung and under the right scapula. Eight years before, she had been told that she had a lesion in the right apex. Three years before, after cleaning house, pain commenced in the right arm and under the right scapula, and a thickening in the neck in this region was noted; both had gradually become more marked. A week before her examination she had had a choking sensation while leaning over a drinking fountain. Aspiration elsewhere had yielded 3 c.c. of straw-colored fluid. She could sleep only on the right side or on the abdomen on account of pressure symptoms. The loss of weight was 18.5 pounds in one and one-half years.

A rough, firm, rather tender mass was palpated in the right supraclavicular space, apparently beginning in the cavity of the chest and running to the apex about 7.5 cm. above the clavicle, and behind the sternomastoid muscle. The percussion note was dull over the upper right lobe from above to the third rib anteriorly and the sixth rib posteriorly. The breath sounds were distant and fremitus increased over this area. The Wassermann reaction was negative at three examinations; a therapeutic test was also negative. The X-ray revealed a circumscribed area of increased density in the right chest, reaching the level of the fourth rib anteriorly, probably due to a tumor. At operation, September 4, the pleura was nonadherent, and appeared to contain fluid, but none was found. The pleura was opened wide without any effect on respiration. A solid, fibrous tumor lay beneath the wound and was apparently not adherent to the chest wall at any point. It was free on the mediastinal side but adherent to the lung in the middle portion of the chest below and continuous with the mass felt in the neck above the clavicle. Two large sections were removed without undue hemorrhage, and the pathologic report on these was myxoma. The entire mass was not removed, and after the patient recovered from the operation she was referred elsewhere for X-ray treatment.

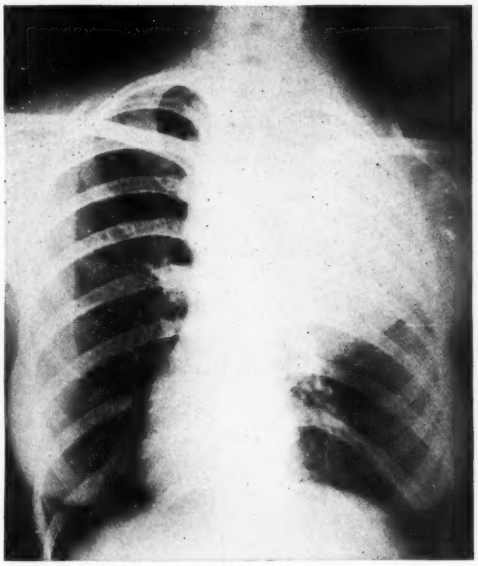


Fig. 1. Circumscribed area of density over the whole upper right lung, due to tumor.

A TOP FOR TESTING TIMING DEVICES

By E. G. C. WILLIAMS, M.D., DANVILLE, ILLINOIS

With the improvement of films, screens and current-controlling devices, very short exposures are gaining a greater importance. The timing apparatus must also be exact and dependable to insure the possibility of repetition of technical results. This is es-

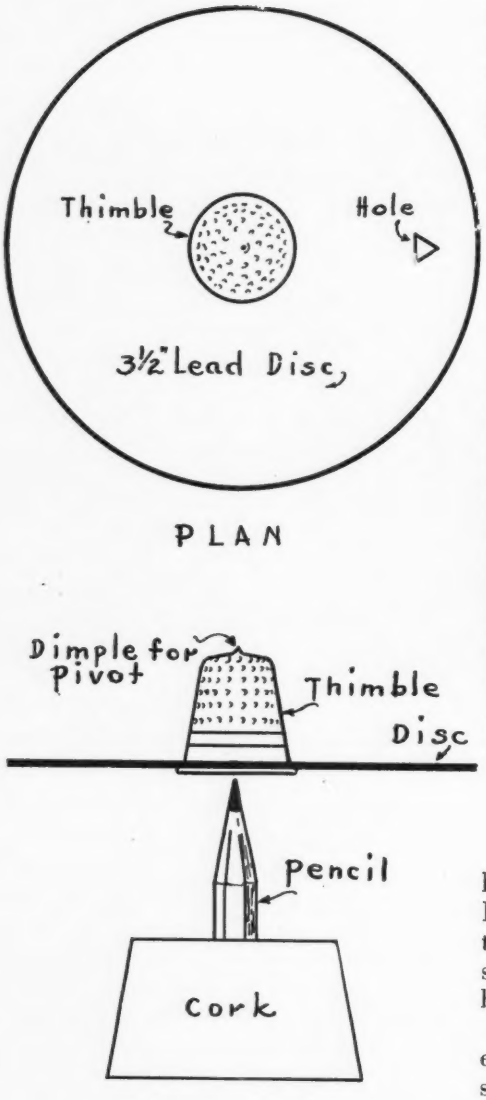


Figure 1.

pecially true of gastro-intestinal serial work.

In the October, 1923, issue of RADIOLOGY, W. Walter Wasson, M.D., of Denver, described an excellent method of testing timing devices and explained the physical principles utilized. We are using a simplified form of a more elaborate device used by the testing department of the Victor factory. The "thimble-top" is easily made and is always ready for use. It consists of a three and one-half inch lead disc with an aluminum sewing thimble pressed through a hole in the center and a small triangular hole cut near the periphery of the disc. Punch a small dimple in the top of the thimble to make a center for the pivot. A sharpened lead pencil held in a cork or rubber stopper forms the pivot.

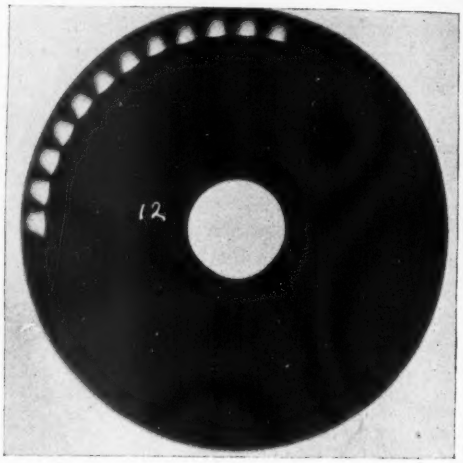


Fig. 2.

Spin the top on the film and make an exposure of 1-10 of a second while it is spinning. The developed film will show like Figure 2. If the timer is accurate there will be twelve spots on the finished film representing 1-10 of the rectified 60 cycle-second.

A 4x5 photographic printing frame was converted into a test cassette by replacing the glass with a piece of cigar box lid and using pieces of a discarded intensifying screen cut to fit the frame. An 8x10 film cut into four pieces makes film of suitable size.

A NEW TYPE OF X-RAY FILM CLIP

By JOHN D. CAMP, M.D., Fellow in Roentgenology, Mayo Foundation, ROCHESTER, MINNESOTA

I have devised a film clip which has proved very serviceable and efficient in the Section on Roentgenology at the Mayo Clinic. Its chief advantages are that it is easily made, inexpensive, and requires neither nails nor screws to hold it in place. As may be seen in the illustration, it is applicable only to view-boxes in which the glass rests on a supporting shoulder of metal or wood; however, most view-boxes are made in this manner. The tension maintained by the spring makes it possible to use the clip with any thickness of glass. It is easily slipped in position over the top edge of the viewing glass, can be slid along from one position to another, and does not prevent the removal of the glass for the purpose of inserting new lamp bulbs or cleaning. After a trial of spring metals of varying thicknesses, "helmet sprint" bronze No. 30 (B and S) gauge, proved the most desirable material for the clip.

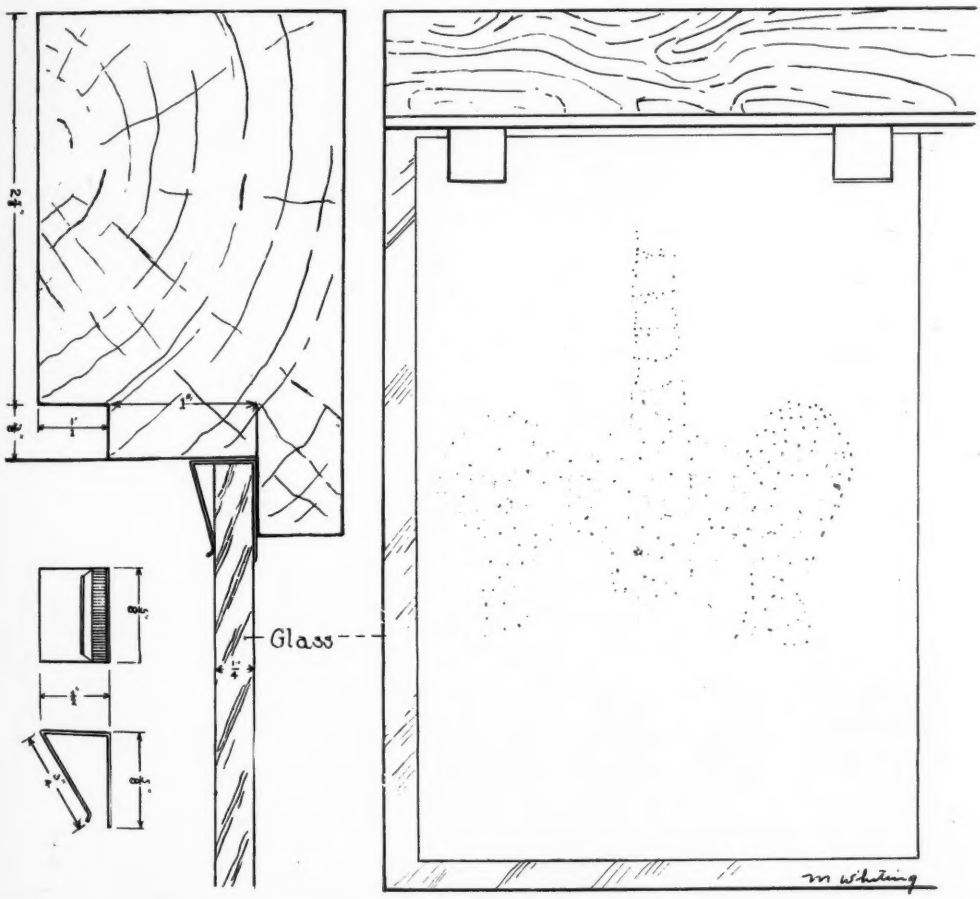


Fig. 1. A cross-section of the top of a view-box with the clip in position; a front view with an X-ray film held in place by two clips, and a working drawing.

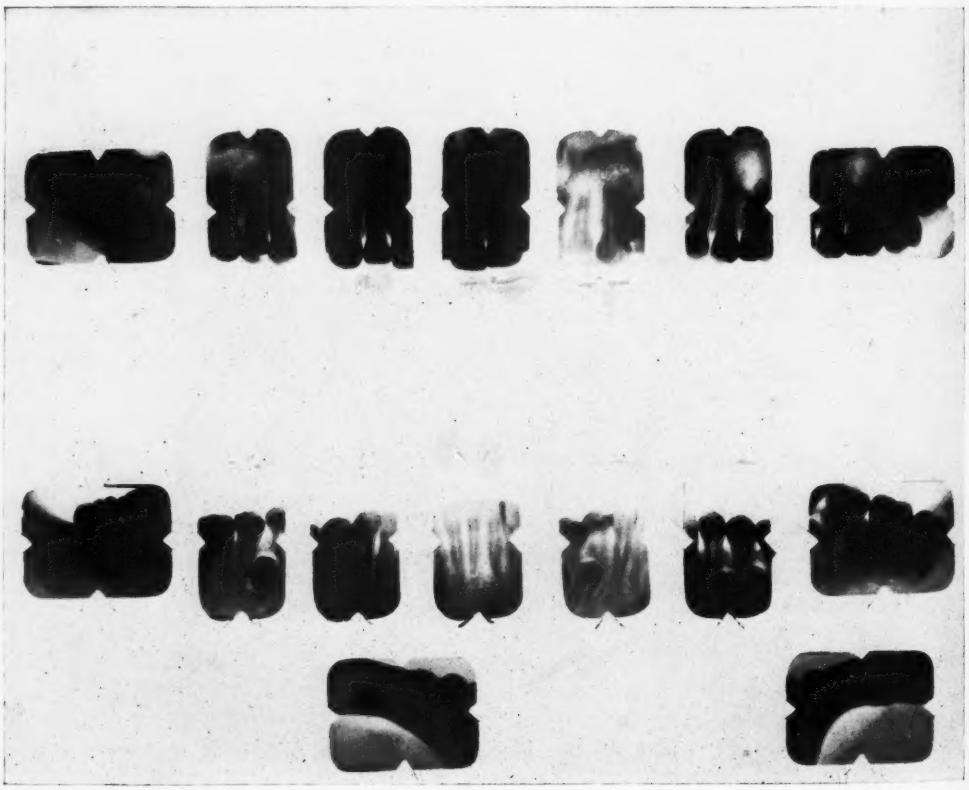
DEPARTMENT OF RADIODONTIA

UNDER THE SUPERVISION OF BOYD S. GARDNER, D.D.S.,
ROCHESTER, MINNESOTA

CASE REPORT

DR. M. R. HOWARD, of Denver, Colorado, reports the following case, illustrated with full-mouth roentgenograms:

The patient, a boy aged 10 years, weighing 100 pounds, first revealed signs of physical disturbance by failing in his school work; later his mind became so affected that it was necessary to leave school. Epileptic attacks followed, as many as three each day. He sometimes was vicious with his mother and his friends, and was afraid to leave his father even in the daytime. After one year and a half, the mouth was examined and clinically appeared to be in good condition. However, a full-mouth roentgenogram disclosed three mandibular supernumerary teeth entirely within the bone, two on one side and one on the other (Fig. 1). There was no bulging of tissue in the mouth to indicate the condition. Two impacted lower third molars and two unerupted upper third molars were also found. The lower left molar was the only pulpless tooth. All of these questionable teeth were removed, and since the last extraction epileptic attacks have ceased and the boy has improved steadily, and has resumed his school work. The patient is now 20 years old, has taken an active part in athletics for the last two years, has learned the bricklaying trade, and is now working every day. He is strong and healthy and weighs over 155 pounds.



THE ROENTGENOLOGIC DIAGNOSIS OF PATHOLOGIC CONDITIONS OF THE JAW[1]

By GORDON B. NEW, M.D., ROCHESTER, MINNESOTA

IN considering the diagnostic value of the roentgen ray in pathologic conditions of the jaw, four groups of cases were studied: (1) benign solid tumors, (2) benign cystic tumors, (3) malignant tumors, and (4) miscellaneous conditions.

Benign solid tumors.—In this group were osteomas (single and multiple), leontiasis ossei, odontomas, giant-cell tumors, fibromas, and myxomas. Benign and malignant tumors of the jaw may, as a rule, be differentiated by the roentgenogram. However, a slow-growing, malignant tumor and a benign tumor present similar characteristics. It is often impossible to determine by the X-ray whether certain benign tumors are solid or cystic. Of the solid benign tumors, the osteoma, the leontiasis ossei, and the odontoma may be diagnosed by the aid of the X-ray. The osteoma presents a dense shadow and may be in a single mass or in multiple small masses around the jaw. Leontiasis ossei presents a diffuse bony thickening of the bones of the face, usually involving the nasal cavity and extending into the orbit. The lower jaw may also be involved. Solid odontoma presents a rounded mass of density similar to that of tooth structures, usually in a cystic cavity in the body of the jaw. It is impossible to distinguish an osteoma from a slow-growing osteosarcoma, or to determine whether a certain benign tumor is a giant-cell tumor, fibroma, or myxoma. The X-ray determines the location and extent of the tumor, but, as a rule, does not aid in determining the cellular pathology.

FIG. 1 (Case A78889).—*Deformity of the lower jaw secondary to osteomyelitis.* End-result of extensive osteomyelitis of the lower jaw which occurred seven years previous to examination. Age of patient, twenty-one years. Note the horseshoe-like remnant of the lower jaw and the absence of teeth. There were multiple scars about the face and neck and marked deformity.

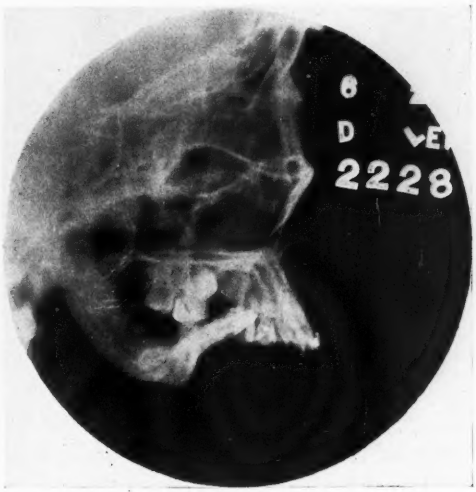


FIG. 2 (Case A2228).—*Congenital deformity of the lower jaw.* Unusual anomaly of the lower jaw, which is very small, and the angle absent. Age of patient, twenty-four years.

Benign cystic tumors.—In this group were osteitis cystica, odontomas (adamantinomas and simple cysts), and inde-

[1]Abstract of paper read at the meeting of the Radiological Society of North America, Rochester, Minnesota, December, 1923.

terminate cysts. The adamantinomas can usually be diagnosed by the aid of the X-ray, the multilocular cyst with trabeculation presenting a characteristic appearance. The differential diagnosis of the simple cysts, osteitis cystica, and the indeterminate group of cysts usually has to be made from the combined clinical and microscopic evidence. In osteitis cystica there is a unilocular cystic cavity, with clean-cut margins. The cystic odontomas may be of three types: (1) the adamantinoma, (2) the simple cyst, Type *a*, commonly called the dentigerous cyst, and (3) the simple cyst, Type *b*, often designated the follicular cyst. The indeterminate group of cysts consists of (1) a cyst often seen at the angle of the jaw, extending up into the ascending ramus, without characteristic findings in the roentgenogram, filled with material resembling cooked oatmeal, with no epithelial lining, and of unknown etiology, and (2) cysts which are definitely inflammatory in origin, secondary to an infected tooth.

FIG. 3 (Case A281931).—*Leontiasis ossei.* Diffuse bony thickening of bones of the face, almost completely obstructing the nostrils and involving the orbits. The patient was twenty-one years of age and had congenital syphilis. The condition had lasted six years.

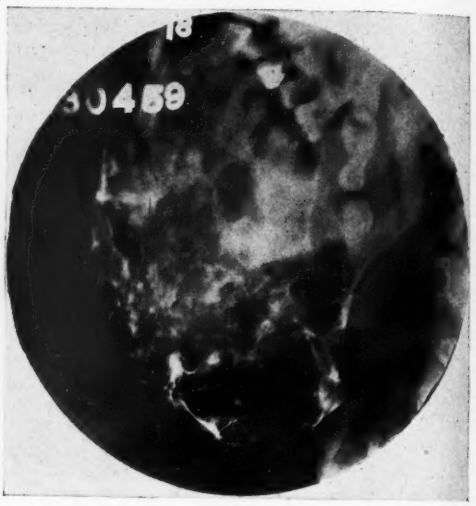


FIG. 4 (Case A230459).—*Fibro-osteoma of the lower jaw.* Huge fibro-osteoma of almost the entire lower jaw. Age of patient, twenty-five years. The condition had lasted fifteen years. The tumor involved the body of the jaw and both sides anterior to the angle, and filled the floor of the mouth anteriorly, displacing the tongue. The tumor had developed into the shape of the upper alveolar process and palate. Note the character of the tumor in the roentgenogram.

Malignant tumors.—The malignant tumors have been divided into primary malignant tumors of the jaw and metastatic tumors. The primary malignant tumors are of two types: soft tissue or surface tumors, and medullary or central tumors. The first type may be squamous-cell epithelioma or periosteal sarcoma, the second osteosarcoma, fibrosarcoma, endothelioma, carcinoma, or the actively growing sarcoma. Roentgenograms of malignant tumors vary, depending on the rate of growth; the slow-growing type resemble the benign. The endothelioma and the medullary carcinoma present a cystic cavity which cannot be differentiated from a simple cyst. Roentgenograms of a rapidly growing epithelioma or sarcoma reveal destruction of the bone, and an irregular moth-eaten appearance of the remaining bone around the tumor. Often a roentgenogram of this type of tumor reveals absence of a large portion of the jaw, with a clean-cut margin of the remaining portion, as if a resection had been performed. The osteosarcoma presents a diffuse bony

mass which is difficult to differentiate from osteoma in a roentgenogram. In cases of metastatic tumors there is bone destruction, but no characteristics to differentiate them from primary tumors.

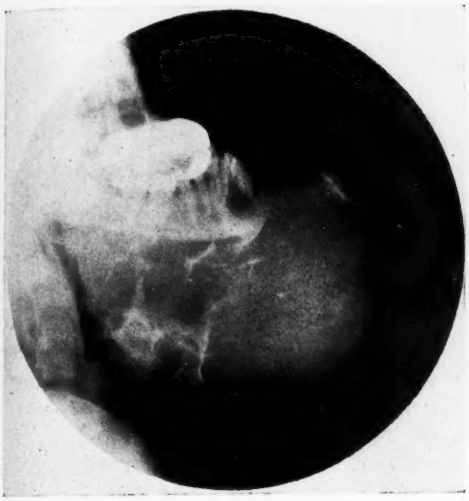


FIG. 5 (Case A177233).—*Adamantinoma of the lower jaw.* Huge tumor of the left side and anterior part of the lower jaw, about 15 by 12.5 cm. in diameter. Age of patient, thirty-one years. The condition had lasted four years. Note the typical multilocular character of the cyst with trabeculation.

The miscellaneous conditions revealed by the roentgenogram are osteomyelitis, acute and chronic; osteomyelitis with sequestrum; deformities of the jaws, congenital or secondary to osteomyelitis; fractures (showing the number, position, and displacement of the fragments); the position of the condyle in dislocation of the jaw, and the presence of foreign bodies, such as the position of a piece of a needle broken off in injecting the

FIG. 6 (Case A292393).—*Osteosarcoma of the lower jaw.* Extensive tumor of the body of the lower jaw. Age of patient, forty-six years. The condition had lasted five years. Roentgenograms revealed that the chest was almost filled with metastatic growth. Because of the gradual involvement the patient was not dyspneic.

inferior dental nerve, or fragments of bullets. In unilateral temporomaxillary ankylosis, occurring before the jaw is fully formed, the X-ray reveals the shortening with the notch anterior to the angle of the involved side, but is of little value in determining whether the ankylosis is fibrous or bony, on account of the overlying bony structures.

Tuberculous adenitis.—The authors report three cases of tuberculous adenitis treated by combined X- and ultra-violet rays, in which they had excellent results. In the first case, with suppurated sterno-mastoid adenitis, the patient received three hours' exposure to the X-rays and nine minutes fifteen seconds' exposure to ultra-violet light in nine séances. The second patient received six and the third, thirty-six treatments. —*X-rays and Ultra-violet Light Associated in the Treatment of Tuberculous Adenitis (Association des rayons X et ultra-violets dans le traitement des adénites tuberculeuses). J. Saidman and R. Robine. Bull. et mém. Soc. méd. des Hôp. de Paris, No. 14, 1923, p. 622.*

EDITORIAL

CLINICAL ROENTGENOLOGY

This is a plea for better co-operation between the internist, the surgeon and the roentgenologist, in order to make better histories, better examinations, better diagnoses, and better service to the patient. Roentgenologists are true consultants in every field of medicine and surgery, but they are not clinicians in any field, and, therefore, should have the clinician's history, with the physical findings, of every case sent to the X-ray department.

If you will go back in the history of the development of the X-ray, you will remember that the clinicians were the first to use X-ray in the practice of medicine and surgery. They soon found out that the field was too large for them to do both, so the work naturally divided itself and roentgenology was divorced from medicine and surgery, becoming a specialty. This specialty grew so fast and seemed so definite in making diagnoses that men were prone to say that they did not need any clinical history or physical findings to enable them to make a correct diagnosis, because the X-ray was infallible and it could not make a mistake.

This method worked for a while, but one would not expect the youngest specialty in medicine to supplant all the older and reliable methods that have been handed down for years. Now the pendulum is swinging in the other direction and the roentgenologist realizes that he needs the clinician as much as the clinician needs him.

One often marvels at the ability of the older clinicians to make a positive diagnosis, and they are the ones who are slow to accept the work of the roentgenologists. This is the way it should be, for they do not expect all the older methods of diagnosis, with the history and physical findings, to be upset by this new science, but are willing to accept all that is based on definite scientific research and observation. All of us are graduates in medicine, surgery and obstetrics and are supposed to know these fundamentals, and some of us have had more or less clinical experience with which to apply these subjects, but on account of the very definite field of roentgenology we have neglected the clinical side of practice. Now we realize that our work is subject to error and that the error is due to one thing —the lack of history and findings. This is well illustrated by those cases in which we find two or more pathological conditions. Recently the writer examined the gastro-intestinal tract of a patient and found three conditions: first, cardiospasm; second, multiple diverticulitis of sigmoid, and third, many gallstones. From the history it was obvious that he was suffering from the gallstones and not the pathology in the colon.

We should not be asked to get the history and make the physical findings for the reason that we do not see the patient first, but they should be furnished with each case before the X-ray examination is started, so that a definite plan of procedure can be outlined for each case. This allows us to think of all the possibilities that are essential in the X-ray examination and how best to accomplish much in the least time.

Should we irradiate only what is requested? I say "No,"—not without consulting the history, because we probably would overlook the real pathology in a large percentage of cases. Another reason is that we are allowing the physicians to make technicians out of us, and as long as we permit that they will do it more and

more. Let me illustrate by the following case, sent in to have her hip irradiated on account of a continuous dull aching pain in that region. We found a rarefied area in the greater trochanter that suggested a carcinoma metastasis. We told the attending physician of our suspicion and then we found out that she had had a carcinoma of the left breast removed some six years before, but that had no bearing on her present condition because she had outlived the five-year period without having any metastasis. We then made stereoradiographs of her chest and found several more nodules in the lung, which confirmed the diagnosis of generalized carcinomatosis.

In making our report to the attending physician we should give him not only a definite statement of our findings in relation to the history, but also report everything else that may possibly help him, such as congenital anomaly. Some men will argue that if the anomaly has no bearing on the case, then why mention it? But if we do not report it, then no one besides ourselves knows about it and there is no way of foreseeing when it may become very important in the life of the patient.

In conclusion, I am convinced that we can do better work and make a larger number of correct diagnoses if we are given the history and physical findings and are allowed to use our own judgment as to what should be irradiated,—thus good team work results.

CHARLES C. GRANDY, M.D.

THE AMERICAN COLLEGE OF RADIOLOGY

The American College of Radiology, organized in San Francisco during the 1923 meeting of the American Medical Association, held its first annual convocation at the Drake Hotel, Chicago, June 11, 1924. The President, Dr. George E. Pfahler, conferred Fellowship degrees upon seven candidates elected by the Board of Chancellors.

Candidates in the College are created by unanimous action of the Board of Chancellors and the present Fellowship is limited to one hundred.

The aims of the College are to assist in elevating the practice of Radiology to the highest possible professional plane, and to create a fellowship among medical men who have devoted at least ten years of their life to X-ray and radium work, and who have distinguished themselves in the science of Radiology and in the service of humanity.

ALBERT SOILAND, M.D.

THE FIRST SESSIONS ON RADIOLOGY

One of the outstanding features of the 1924 meeting of the American Medical Association was the splendid showing made at the first Sessions on Radiology held in the Section of Miscellaneous Topics.

To the Chairman of the temporary Section, Dr. W. F. Manges, belongs all credit for the excellent program presented. In spite of the fact that the Sessions on Radiology were held on the last two days of the Convention the attendance was remarkable. Thursday's roll registered 372, and Friday's 300, a great many of whom were not members of the regular societies devoted to X-ray and radium work. The Chairman of the Council of Scientific Assembly, Dr. J. Shelton Horsley, came in during one session and addressed the meeting. He stated that he was greatly surprised at the excellent work demonstrated at this meeting, and that while he could not speak officially he believed the Council would recommend to the House of Delegates of the American Medical Association that the Radiologists be granted a full Section in the Association. In the meantime the writer had presented the following resolutions to the House of Delegates:

WHEREAS, The Radiological Society of North America, through the president, executive committee and counselors, unani-

mously resolved to favor the creation of a Section of Radiology in the American Medical Association; and,

WHEREAS, The Radiological Society of North America, consisting of 800 members, who are Fellows of the American Medical Association, is represented in every state of the Union, Canada, Cuba, etc.; and,

WHEREAS, The members of the American Roentgen-ray Society and the American Radium Society also approve the substance of these resolutions; and,

WHEREAS, In executive session on Thursday evening, June 5, 1924, and on June 6, 1924, voted unanimously to adopt this resolution, and also that Dr. Albert Soiland, former president of the Radiological Society of North America and a Delegate from California to the American Medical Association, be respectfully requested to present this resolution before the House of Delegates during the session in Chicago; Be It Therefore

RESOLVED, That the temporary Section on Radiology in the American Medical Association be made permanent.

This was referred to the Reference Committee on Sections and Section Work, and was returned to the House of Delegates with favorable recommendation by the Committee. The House accepted this report and referred same to the Council of Scientific Assembly for action.

From these events it now seems an assured fact that next year the Council will report favorably upon our request, and that 1924 will see inaugurated that for which we have so long sought recognition, a full and a representative Section on Radiology in and a part of the American Medical Association.

ALBERT SOILAND, M.D.

Members of the Radiological Society of North America and their guests, Chicago, June 6, 1924

THE CHICAGO MEETING

The recent meeting, held in Chicago June 6th and 7th, inclusive, was well attended, demonstrating the constant, healthy growth of this organization.

The reasons for this growth are apparent, being due to the democratic spirit of the membership and the excellence of the program.

This Society has fostered and encouraged the attendance of the ladies and other members of the family. This feature is growing exceedingly popular, as it promotes a better acquaintance among the members and their families, thereby stimulating a community interest.

The banquet was well attended, and enjoyed by all. One feature of it was a cotillion, in which nearly all participated. The principal speakers of the evening were: Doctors William Allen Pusey, George E. Pfahler, William A. Evans of Chicago, James T. Case, and C. Regaud.

Dr. William Allen Pusey, President of the American Medical Association, a pioneer exponent of radiotherapy, spoke of some of his early X-ray work and concluded by saying that merited recognition was certain to be accorded Radiology.

Dr. George E. Pfahler, of Philadelphia, President of the American College of Radiology, spoke on the organization of the College, its aims, purposes, and hopes.

Dr. William A. Evans of Chicago, a pioneer in public health work, acclaimed the boon to humanity which the X-ray has proven itself to be.

Dr. James T. Case of Battle Creek, Michigan, President of the American Radium Society, gave a very interesting dissertation on radioactivity.

The Society was honored by the presence of Dr. C. Regaud, from the Pasteur Radium Institute of the University of Paris. He spoke of the manifold uses of radiant energy as applied to the practice of medicine; that because of its comprehensiveness, a high degree of specialization is necessary, and to further its more universal application along standardized lines, international relations for the exchange of ideas and knowledge should be encouraged and established.

The exhibitors were all represented, showing many new devices and improvements in apparatus.

X-RAY AND RADIUM PROTECTION COMMITTEE

REVISED REPORT NO. 1

(December, 1923)

Chairman

Sir Humphry Rolleston, K.C.B., President of the Royal College of Physicians.

Members

Sir Archibald Reid, K.B.E., C.M.G. (St. Thomas's Hospital).
Dr. Robert Knox (King's College Hospital).
Dr. G. Harrison Orton (St. Mary's Hospital).
Dr. S. Gilbert Scott (London Hospital).
Dr. J. C. Mottram (Pathologist to the Radium Institute).
Dr. G. W. C. Kaye, O.B.E. (National Physical Laboratory).
Mr. Cuthbert Andrews.

Honorary Secretaries

Dr. Stanley Melville (St. George's Hospital).
Prof. S. Russ (Middlesex Hospital).

Address

% Royal Society of Medicine, Wimpole Street, London, W.1.

The X-ray and Radium Protection Committee presents a revised edition of its preliminary report first issued in July, 1921.

The new report contains a considerable number of alterations and additions based largely on the experience of the National Physical Laboratory in its inspection work carried out for the last two years or more in co-operation with the Committee.

Copies of the report may be had on application to the Director, National Physical Laboratory, Teddington, Middlesex.

INTRODUCTION

The danger of over-exposure to X-rays and radium can be avoided by the provision of efficient protection and suitable working conditions.

The known effects on the operator to be guarded against are:

1. Visible injuries to the superficial

[1]From *The British Journal of Radiology*, January, 1924.

tissues, which may result in permanent damage.

2. Derangements of internal organs and changes in the blood. These are especially important, as their earlier manifestation is often unrecognized.

GENERAL RECOMMENDATIONS

It is the duty of those in charge of X-ray and radium departments to ensure efficient protection and suitable working conditions for the *personnel.*

The following precautions are recommended:

1. Not more than seven working hours a day.

2. Sundays and two half-days off duty each week, to be spent as much as possible out of doors.

3. An annual holiday of one month or two separate fortnights.

Sisters and nurses, employed as whole-time workers in X-ray and radium departments, should not be called upon for any other hospital service.

PROTECTIVE MEASURES

It cannot be insisted upon too strongly that a primary precaution in all X-ray work, whether with stationary or portable sets, is to surround the X-ray bulb itself as completely as possible with adequate protective material, except for an aperture as small as possible for the work in hand.

The protective measures recommended are dealt with under the following sections:

I. X-rays for diagnostic purposes.
II. X-rays for superficial (low-voltage) therapy.
III. X-rays for deep (high-voltage) therapy.
IV. Electrical precautions in X-ray departments.
V. Ventilation of X-ray departments.
VI. X-rays for industrial and research purposes.
VII. Radium therapy.

It must be clearly understood that the protective measures recommended for these various purposes are not necessarily interchangeable; for instance, to use for deep therapy the measures intended for superficial therapy would probably subject the worker to serious injury.

It should be further pointed out that the protective values of certain materials are much affected by a change in the voltage applied to the X-ray tube. This applies particularly to materials in which lighter elements than lead furnish the chief protection. The importance of obtaining a National Physical Laboratory test in this connection is emphasized. In the case of protective slabs or plasters made up of a mixture of materials, the difficulty of securing uniform mixing should be met by a generous margin of safety in estimating the required thickness.

I. X-RAYS FOR DIAGNOSTIC PURPOSES

1. *Screen Examinations.*

(*a*) The X-ray bulb should be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead. The material of the diaphragm should be equivalent to not less than 3 mm. of lead. The design of the diaphragm should be such as to permit it to be completely closed. The simpler rectangular forms of diaphragm will, in general, be found preferable to the iris type.

In the case of installations which are incapable of generating peak voltages exceeding 70,000, the lead value of the tube enclosure may be reduced to 1.5 mm. and of the diaphragm to 2 mm.

(*b*) The fluorescent screen, attached as a permanent fitting to screening stands, etc., should be fitted with lead glass equivalent to not less than 2 mm. of lead. In all positions the lead glass should be large enough to cover the area irradiated when the diaphragm is opened to its widest. For screens of smaller area, the lead glass should be mounted in a frame of protective material which overlaps the screen and is of adequate width and thickness to afford protection in all positions of the screen. In the case of portable screens considerations of weight militate against the recommenda-

tion of a degree of protection greater than 1 mm. of lead. As far as possible, the glass should be of uniform thickness and free from striations and air bubbles.

(*c*) To afford protection from scattered radiation in the case of a couch, a protective screen, mounted on the carriage and of material equivalent to not less than 2 mm. of lead, should be employed between the operator and the X-ray box. In addition, a device such as a "collar" of protective material between the tube box and the underside of the couch is effective. In the case of a screening stand, an "apron" of protective material should be attached to the lower edge of the screen, and panels of protective material mounted on each side of the patient.

(*d*) Protective gloves should be of lead rubber (or the like) and afford protection for both back and front of hand (including fingers and wrist). The protective value should be not less than ½ mm. of lead. Gloves should preferably be lined with leather or other suitable material. (As practical difficulties militate at present against the recommendation of a greater degree of protection, all manipulations during screen examination should be reduced to a minimum.)

(*e*) In those cases where the necessity is felt for even greater protection for the operator, goggles and aprons may advantageously be worn. The glass of the goggles should have a lead value not less than ½ mm.; aprons should have lead values not less than 1 mm.

(*f*) A minimum output of radiation should be used with the bulb as far from the screen as is consistent with the efficiency of the work in hand. Screen work should be as expeditious as possible.

2. *Radiographic Examinations ("overhead" equipment).*

(*a*) The X-ray bulb should be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead. This figure may be reduced to 1.5 mm. in the case of installations which are incapable of generating peak voltages exceeding 70,000.

(*b*) The operator should stand behind a protective screen of material equivalent to not less than 2 mm. of lead. In general, such screens should not be less than 3 ft. 6 in. wide and 7 ft. high and should extend to within 1 in. of the ground. If a window is provided, its lead equivalent should not be less than 2 mm. Its dimensions need only rarely exceed 9 in. by 6 in.

II. X-RAYS FOR SUPERFICIAL (LOW-VOLTAGE) THERAPY

It is difficult to define the line of demarcation between superficial and deep therapy.

For this reason it is recommended that, in the reorganization of existing, or the equipment of new, X-ray departments, small cubicles should not be adopted, but that the precautionary measures suggested for deep therapy should be followed.

The definition of superficial therapy is considered to cover sets of apparatus giving a maximum peak voltage of 100,000 (15 cm. spark gap between points; 5 cm. spark gap between spheres of diameter, 5 cm.).

Cubicle System

Where the cubicle system is already in existence it is recommended that:

1. The cubicle should be well lighted and ventilated, preferably provided with an exhaust electric fan in an outside wall or ventilation shaft and suitable air inlets. The controls of the X-ray apparatus should be outside the cubicle.

2. The walls of the cubicle should preferably not take the form of partitions, but should extend from floor to ceiling. If partitions are adopted, they should be not less than 9 ft. in height and extend to floor level.

3. The walls (and where necessary, the floor and ceiling) of the cubicle should be of material equivalent to not less than 2 mm. of lead. Windows should be of high quality lead glass of equivalent thickness. They need only rarely exceed 9 in. by 6 in.

in dimensions. Care should be taken that the protective material overlaps at joints.

4. The X-ray bulb should be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead. This figure may be reduced to 1.5 mm. in the case of installations which are incapable of generating more than 70,000 volts.

III. X-RAYS FOR DEEP (HIGH-VOLTAGE) THERAPY

This section refers to sets of apparatus giving peak voltages above 100,000.

1. Small cubicles are not recommended.

2. A large, lofty, well-ventilated and lighted room should be provided, preferably provided with an exhaust electric fan in a suitable air duct.

3. The walls (and where necessary, the floor and ceiling) of the room should provide protection equivalent to not less than 3 mm. of lead. Windows should be of high quality lead glass of equivalent thickness. They need only rarely exceed 9 in. by 6 in. in dimensions. Care should be taken that the protective material overlaps at joints.

4. The X-ray bulb should be enclosed as completely as possible with protective material equivalent to not less than 3 mm. of lead.

5. A separate enclosure should be provided for the operator, situated as far as possible from the X-ray bulb. All controls should be within this enclosure, the walls and windows of which should be of material equivalent to not less than 3 mm. of lead.

IV. ELECTRICAL PRECAUTIONS IN X-RAY DEPARTMENTS

1. Wooden, cork, lino or rubber floors should be provided; existing concrete or similar floors should be covered with one of the above materials.

2. Stout metal tubes or rods terminating in spheres should, as far as possible, be used instead of wires for conductors. Overhead conductors should not be less than 9 ft. from the floor level. The connecting leads from the overhead conductors to the X-ray tube should be brought down in positions as remote as possible from the operator and patient. The provision of thick-walled insulating tubing to shield the more adjacent parts of the connecting leads is recommended. Thickly insulated wire is preferable to bare wire. Slack, looped or low hanging wires should be avoided. Small spring tapes should be replaced by rheophores of robust design with heavily insulated wire.

3. All metal parts of the apparatus and room should be efficiently earthed.

4. All main and supply switches should be very accessible and distinctly indicated. It should not be possible to close them accidentally. Wherever possible double-pole switches should be used in preference to single-pole. Fuses no heavier than necessary for the purpose in hand should be used, together with quick-acting double-pole circuit breakers. The possibility of unemployed leads to the high-tension generator should be prevented by interlocking switches or the like.

5. Alternative spark gaps (preferably of the sphere type), should be provided. They should be furnished with cm. or inch scales, together with a voltage scale. The spark gaps should be situated in positions where they can easily be read and adjusted while the tube is in operation.

V. VENTILATION OF X-RAY DEPARTMENTS

1. It is strongly recommended that the X-ray department should not be below the ground level. In general, ceilings should not be less than 11 ft. in height. The presence of steam piping and the like must be allowed for. Damp rooms should be avoided.

2. The importance of adequate ventilation in both operating and dark-rooms is supreme. Artificial ventilation is recommended in most cases. With very high potentials coronal discharges are difficult to avoid, and these produce ozone and nitrous fumes, which are prejudicial to the operator. Rotating rectifiers often require the

provision of a special ventilating duct or like measure. Unenclosed rectifying spark gaps are better replaced by enclosed types. If vacuum valves are used, the fact that they may produce X-rays should not be lost sight of.

All rooms, including dark-rooms, should be capable of being readily opened up to sunshine and fresh air when not in use. The walls and ceilings of all rooms, including dark-rooms, are best painted some light hue.

VI. X-RAYS FOR INDUSTRIAL AND RESEARCH PURPOSES

The preceding recommendations will probably apply to the majority of conditions under which X-rays are used for industrial and research purposes.

VII. RADIUM THERAPY

The following protective measures are recommended for the handling of quantities of radium up to one gram:

1. In order to avoid injury to the fingers the radium, whether in the form of applicators of radium salt or in the form of emanation tubes, should always be manipulated with forceps (preferably wooden) or similar instruments, and it should be carried from place to place in long-handled boxes lined on all sides with 1 cm. of lead.

2. In order to avoid the penetrating rays of radium all manipulations should be carried out as rapidly as possible, and the operator should not remain in the vicinity of radium for longer than is necessary.

The radium when not in use should be stored in an enclosure, the wall thickness of which should be equivalent to not less than 8 cm. of lead.

3. The handling of emanation should, as far as possible, be carried out during its relatively inactive state. In manipulations where emanation is likely to come into direct contact with the fingers thin rubber gloves should be worn. The escape of emanation should be very carefully guarded against, and the room in which it is prepared should be provided with an exhaust electric fan.

GENERAL

The governing bodies of many institutions where radiological work is carried on may wish to have further guarantees of the general safety of the conditions under which their *personnel* work.

1. Although the Committee believe that an adequate degree of safety would result if the recommendations now put forward were acted upon, they would point out that this is entirely dependent upon the loyal co-operation of the *personnel* in following the precautionary measures outlined for their benefit.

2. The Committee would also point out that the National Physical Laboratory, Teddington, is prepared to carry out exact measurements upon X-ray protective materials and to arrange for periodic inspection of existing installations on the lines of the present recommendations. (See Report No. 2.)

3. Further, in view of the varying susceptibilities of workers to radiation, the Committee recommend that wherever possible periodic tests, *e.g.*, every three months, be made upon the blood of the *personnel*, so that any changes which occur may be recognized at an early stage. In the present state of our knowledge it is difficult to decide when small variations from the normal blood-count become significant.

REPORT NO. 2

In view of the widespread uncertainty and anxiety as to the efficacy of the various devices and materials employed for the purposes of protection against X-rays, the X-ray and Radium Protection Committee strongly advise that the Heads of X-ray departments of hospitals and other institutions should safeguard themselves and their staffs on this score by recommending to the hospital authorities the adoption of the following precautions:

1. The various protective appliances should be inspected and reported on by the

National Physical Laboratory (N.P.L.), Teddington. In the event of an adverse report, early steps should be taken to carry out the recommendations of the Laboratory. The Laboratory is prepared, wherever possible or expedient, to engrave (or otherwise suitably mark) the N.P.L. monogram and year of test on such appliances as provide the full measure of protection laid down in the Revised Report No. 1 of the Protection Committee. It should be pointed out that, in the case of materials which may deteriorate, *e.g.*, lead rubber, such inspection should be periodic, say, every twelve months.

2. Within the Committee's recent experience, the working conditions of X-ray departments, *e.g.*, lay-out of installations, degree of scattered radiation, ventilation, high-tension insulation, etc., are often unsatisfactory. It is recommended that such conditions be inspected by the N.P.L. and that early steps be taken to give effect to such alterations as may arise out of their report. It is advised that, in the planning of new radiological departments, advantage be taken of the facilities available at the N.P.L.

3. Manufacturers of X-ray apparatus are also invited to assist in reassuring the public by actively co-operating with the Committee in its recommendations. It is suggested that protective materials or equipment should not be sold or incorporated into an installation unless accompanied by a specification based upon an N.P.L. certificate or report stating, in terms of the equivalent thickness of lead, the degree of protection afforded.

In the interests of both the trade and profession, it is urged that manufacturers should put themselves into a position to be able to guarantee that their apparatus complies completely with the recommendations of the Committee.

4. The Committee recommend that the various instruments dealing with the measurement of current (ammeters and milliammeters) and voltage, be standardized by the N.P.L. With reference to the measurement of secondary voltage, the Committee recommend that every installation should be provided with adequate means for enabling this to be easily effected, *e.g.*, by kilovoltmeter, sphere-gap voltmeter or the like.

5. The Committee would further urge that Heads of X-ray departments should insist upon complete N.P.L. inspection of imported materials and apparatus.

BOOK REVIEWS

RADIUM, X-RAYS AND THE LIVING CELL, WITH PHYSICAL INTRODUCTION, BY HECTOR A. COLWELL, M.B. (LOND.), D.P.H. (OXFD.), ASSISTANT RADIOLOGIST, KING'S COLLEGE HOSPITAL, AND SIDNEY RUSS, D.SC. (LOND.), F.INST. P.; JOEL PROFESSOR OF PHYSICS, THE MEDICAL SCHOOL, MIDDLESEX HOSPITAL; FELLOW OF UNIVERSITY COLLEGE, LONDON. Second edition, revised. London, G. Bell and Sons, Ltd., 1924. Price, 21 shillings.

The second edition of this valuable English text is now available. To the radiologic neophytes who have not been initiated into the values of this book, it may be stated that Colwell and Russ have planned this treatise to describe and collate the main experimental *facts* which have been *established* as to the effects of X-rays and rays from radium upon living cells.

The original edition embarked upon a conservative but industrious career in 1915. Undoubtedly, it has been quoted in the bibliographies of radiotherapeutic articles more than any other book or article extant. There's a reason!

Explanations are not required by those familiar with the sourceful capacities of this book to explain the effects of alpha, beta and gamma rays upon the living normal cell and the malignant cell. Of course, this second edition provides an extension of several chapters to include new experimental data and one additional chapter in which the authors summarize the outstand-

ing features of radiation therapy and theorize gently upon the reasons therefor.

This chapter is typically Anglo-Saxon and so genuinely simple as to force blushes to certain bombastic American articles. Probably some Teutonic authors, if they possibly could understand this English simplicity, would suffer an allergystic enlargement of the tissues above the collar.

Listen, prithee, to these simple sentences. Cogitate upon their comprehensiveness! Meditate upon their import! Assimilate their contained knowledge!

"Laws of Effects of Radiation" (Colwell and Russ):

"1. The cells of some tissues are more affected by a given dose of radiation than are the cells of other tissues when exposed to the same dose.

"2. In some cases, at least, the cells of a tissue are more affected by a given amount of energy of one range of wave-lengths than they are by the same amount of energy of another range of wave-lengths.

"3. Some cells when in an active state of division are more affected by a measured dose of radiation than are similar cells in the resting state.

"4. Some cells respond to a dose of radiation in different ways, according to whether such radiation is administered so that a large intensity is coupled with a short period of exposure, or a small intensity is coupled with a large period of exposure.

"5. Some cells are stimulated in their growth by a small dose (or doses) of radiation; but inhibition of growth or damage results from the administration of large doses."

Years ago—or was it paragraphs?—it was remarked that the initiated required no explanations of reasons for having this well-thumbed volume upon their reference shelf. To the new worker in radiology, however, we would disclose the values of this treatise. Colwell and Russ have pieced together into chapter mosaics the best experimental facts upon radiant energy. These fragments of fact from every source upon particular tissues are fitted together and present a composite viewpoint of inestimable value to every searching student in radiology. For instance, after Part I (90 pages), upon X-ray and Radium Physics, Part II, with twenty-one chapters, engages to explain the action of X-rays and Radium in Varying Doses and by Various Experimenters, upon Seeds, Plants, Bacteria, Developing Forms of Life, Skin, Blood-vessels, Blood, Spleen, Thymus and Thyroid, Digestive Tract and Glands, the Nervous System, Eye, Muscle, Cartilage and Connective Tissue, the Generative System, Malignant Cells, the Production of Malignant Disease, Idiosyncrasy and Dosage, Physiological, Selective and Differential Action of the Rays, Brief Summary of Facts and Theories.

The scope of the book is thus disclosed. We would like to pick some one chapter to show how comprehensively each tissue has been analyzed under radiation exposures. Take the eye chapter. How often do patients ask if there is going to be any effect from X-ray exposures upon their eyes, etc.? Perhaps you would like to know, too. *Voila!* Secure this volume and all such questions are answered with the truthfulness of an English scientist. Of course, this may not be as satisfactory as a Marktwainian Yankee radiotherapeutic yarn, but it is the stuff that makes for radiologic rationale and morale.

We unhesitatingly commend this volume to every student who does not possess it. To those familiar with the first edition, words of praise are superfluous, but this second edition is not.

E. H. Skinner, M.D.

Principles of X-ray and Radium Dosages. By Albert Bachem, Ph.D. Contains 274 pages. Illustrated with 17 engravings and 38 charts. Publishers: Albert Bachem, Ph.D., 502 Oakwood Boulevard, Chicago.

The author of this book presents in a very effective and concise manner the essential X-ray dosage factors; discusses in

detail the possible relative values of the quantity and quality of X-ray and radium radiations to the known biological cancer phenomena; and then gives very timely emphasis to the point that these important factors should be more thoroughly understood by the radiologist upon whose shoulders greater responsibilities are multiplying day by day in the treatment of malignant tumors.

The early pages are limited to a discussion of the various methods of measuring both the intensity and the hardness of X-rays, with special reference to the *quality* of the radiation spectra.

Simple pastille and photographic methods of measuring the superficial and unfiltered radiations have been, of necessity, superseded by the more recent complicated wave length and ionization chamber determinations.

The problem of measuring the correct dosage in the former superficial radiation therapy was extremely simple, compared to the measurement of the present more difficult, deeper penetrating X-rays. However, the author has apparently made every effort to present to the reader the latter more complicated dosage-determinations in a thorough and complete manner, featuring the technical problems by many illustrations and simple, practical X-ray problems.

The third chapter is limited to a review of the distribution of X-rays and radium in various media, including a discussion of the biological differences between hard rays, soft rays, and corpuscular rays on the basis of the most recent physical and biological investigations.

In Chapter IV the question of relative and absolute dosage is reviewed, beginning with a consideration of the standardization of roentgen installations and the value of periodic checking of the output of such equipments by the determination of the practical dose from the standpoint of the surface and depth radiations within the body tissues, and then finally also considering the important determination of the total energy so applied.

The medical literature of the physics of X-rays and radium and its relation to the many possible biological effects has been voluminously reviewed, both abroad and in this country, by many scientists. However, the author of this book has been more than successful in having covered these complicated subjects in so thorough and practical a manner, and we would unhesitatingly recommend that every radiologist should avail himself of the opportunity of studying the wealth of information contained in this valuable and timely contribution.

EDWIN C. ERNST, M.D.

ABSTRACTS OF CURRENT LITERATURE

Roentgen-ray castration. — In both sexes there are certain definite indications for castration. Such castration may be of temporary or permanent type. When temporary castration is indicated, as in the case of tuberculosis or Basedow's disease, if there is later recovery or sufficient improvement, sexual regeneration may be effected and pregnancy may become possible.

Seitz and Wintz calculated an exact "castration dose" of X-rays for the woman. This was from 30 to 32 per cent of the erythematous dose in the case of temporary castration; 36 per cent gave permanent castration. Of course, there is much variation in the effects of these doses when applied to different individuals, as the sensitiveness of individuals varies.

In the case of men the conditions for castration are not so well known, and Schinz describes certain personal experimental investigations of his own. These investigations had for their scope the radio-sensitization of spermatoids *in vitro*, spermatic atrophy after irradiation, the study of the resistance of the Sertoli cells, etc. As a general rule azoospermia can be observed in about 3 weeks after irradiation. Sterilization in man by the X-rays is rare and the author cites only five cases besides one case which he has himself seen. This was the case of a man aged 35 years, the father of eight children, who in a fit of mental depression, considering himself unable to support a large family, claimed castration, to which his wife agreed. He was rec-

ommended to have a bilateral testicular extirpation, but, being unable to get this done, the man submitted to radiation treatment. He first received a 35 per cent erythema dose through a filter of 3 mm. aluminium, 35 cm. spark, cathode distance 22 cm., with the intensity of 2½ ma. and 12-minute exposure of each field on the anterior side. Two weeks later the same dose was repeated on the dorsal side. One week later the sperm was still rich in mobile spermatozoa. In the fourth week the full erythema dosage was employed with a 5 mm. filter on the anterior face. Two weeks later the spermatozoa were few and immobile. Two weeks later still about three-fourths the erythema dose was applied and the final, almost full, erythema dose was applied four weeks after this. All examinations then showed the sperm negative as regards spermatozoa and the man had become sterile although preserving sexual potency. The author thinks that the castration radiation dose for man varies, is higher in the case of men than in women, and that in the case of man it approximates the dosage for sarcoma. The dosage for permanent aspermatogenesis would be about 60 per cent of the erythema dose, instead of 35 per cent as in the case of women, and the dosage to bring about testicular atrophy would necessarily have to be much higher.—*Radiocastration in Man (Ein Beitrag zur Roentgen-Kastration beim Mann). H. R. Schinz. Schweiz. Mediz. Wchnschr., Sept. 7, 1922, p. 886.*

Pott's disease and vertebral cancer.—Radiography may be the only means of differential diagnosis between Pott's disease and cancer of the spinal column, and the authors give details of cases to show the value of radiography in this respect. In Pott's disease radiography shows thinning of one intervertebral disc with approximation of the adjacent vertebræ, and such radiologic sign may precede any change in transparency of the vertebra in question. When the tubercular process is advanced and has greatly involved the vertebral body, especially at the expense of its anterior face, it gives a cuneiform radiographic image with the summit toward the front. Pott's disease is an osteo-arthritis and even if but one vertebra is attacked the intervertebral discs immediately above and beneath it are thinned and deformed or even destroyed. But in cancer of the vertebral column the authors found that profile radiographs of the column showed erosion amounting almost to total destruction of the vertebræ, with complete integrity of the adjacent intervertebral discs. These radiographic findings offer a criterion between Pott's disease and cancer of the column. In three cases where the cancer radiographic image was obtained, one was verified anatomically and the clinical findings in the other two were quite demonstrative.—*Radiographic Diagnosis of Vertebral Cancer with Radiculo-medullary Compression (Cancer vertébral avec compression radiculo-médullaire; diagnostic radiographique). Sicard, Forestier, and Lermoyez. Bull. et mém. Soc. méd. d. Hôp. de Paris, XLVI, 1922, p. 945.*

Ovarian tumor diagnosed by pneumoperitoneum.—A girl 14 years of age showed a voluminous abdominal tumor which two physicians had diagnosed as normal pregnancy. The author being in doubt, submitted the girl to injection of air in the abdomen over the radiologic screen and placed her in the Trendelenburg position so that the inferior pole of the tumor was projected into the pelvis. A radiograph of the tumor thus obtained left no doubt of the nonexistence of a fetus, and the diagnosis of ovarian tumor was made, which was confirmed by operation. Pneumoperitoneum in this case did not cause the least inconvenience to the patient; it permitted the radiogram to be obtained and by making the contours of the neoplasm evident confirmed its real nature.—*Pneumoperitoneum by the X-rays as a Means of Diagnosing Ovarian Tumors (El neumo-peritoneo en los rayos X, como contribución al diagnóstico de los tumores del ovario). A. Chueco. Semana méd., Buenos Aires, Nov. 9, 1922, p. 948.*

Treatment of lymphomata.—Since the introduction of deep irradiation by the School of Freiburg, 1913, the development of the treatment of lymphadenitis at the Roentgen Institute at Lund has been characterized by this method of deep irradiation with aluminium filter of 3 to 4 mm., secondary cotton or leather filters, 18 to 20 cm. focal distance, and doses varying from 1½ to 5 H. (For children, 2 to 3 H.)

Edling divides lymphadenitis clinically into three phases: simple hyperplasia of the glands; formation of masses with periadenitis; suppuration with fistula, etc.

The cases observed at Lund numbered 206. Of these, 70 were in the first clinical stage, 32 in the second, and 104 in the third. In Group 1 there was a recovery of 70 per cent; in Group 2 of 56 per cent, and in Group 3 of 84 per cent. Besides these, improvement was noted in many others. There were 3 recurrences in Group 1, and 2 in Group 3. There were 8 deaths.

The period of treatment was, on the average, 6½, 8, and 10 months in the three groups, respectively. In the cases of the first group a favorable result from roentgen-ray treatment has generally been recorded unless the lymphomata have already been strongly indurated.

In suppurative cases minor surgery is combined with the roentgen therapy. Usually the

abscess is first incised, scraped and tamponed, after which the fistula is allowed to close.

Statistics of comparison with the surgical treatment of lymphomata at the Heidelberg clinic and others show that radiotherapy gives a much higher percentage of recovery, i.e., 77 per cent, as against 54 per cent after surgical treatment, with a smaller percentage of recurrence. The roentgen-ray treatment has, however, its own risks of secondary skin lesions, though these may be avoided by careful technic. No serious skin trouble, such as atrophy, was observed by the author in any case. The radiological treatment has also the disadvantage that it is of long duration. Operation is preferable for solitary and mobile lymphomata without softening, as well as in cases in which there are large masses of indurated glands that have not been reduced after a long period of irradiation.—*Results of Treatment of Tuberculous Lymphadenitis by X-rays at Lund (Résultats de notre traitement de la lymphadénite tuberculeuse par les rayons X à Lund). L. Edling. Acta Radiologica, Stockholm, I, Fasc. IV, p. 455.*

Epitheliomata.—In connection with ectodermic epitheliomata the dogma has been generally accepted that tumors of the baso-cellular type are highly radio-sensitive and should be treated by radiation, while so-called spino-cellular tumors are very radio-resisting and indicate surgical treatment. From histological considerations Lacassagne shows that the phenomena of cellular radio-sensitiveness do not depend upon morphological characters but are the consequence of the physiological states of the cells. Metabolic hyperfunctioning, reproductive activity, functional transformations, new differentiations, are accompanied by a particular fragility of the cells.

In the case of an epithelioma of ectodermic type of the skin or of a mucous membrane, the fact that histologic examination shows a spino-cellular corneal type of structure no longer implies that the treatment should be surgical. While many non-epidermoid epitheliomata show to a marked degree the characters that imply radio-sensitiveness, the absolute difference between the radio-sensitiveness of baso-cellular and spino-cellular tumors in general (which appeared manifest when the rays used had neither the penetration nor the selectivity possessed by those furnished by modern apparatus) was one especially of appearance. Taking everything into consideration, it may be said that, other things being equal, epidermoid and non-epidermoid tumors are to-day equally well cured by radiotherapy.

On account of the doubts which still prevail with many, in regulating the dosage of the rays according to the apparent radio-sensitiveness, Lacassagne says that it is his practice, no matter what the type or structure of the epithelioma, to administer the maximum dose compatible with the integrity of the healthy tissues.

The histological variety of cancer is only one of the factors which enter into radiotherapeutic success, and which ought to be considered in choosing the treatment. Two other essential factors are: (1) the anatomo-clinical extent and situation of the lesions, and (2) the qualities of the technic employed.—*Importance of Histology in the Appreciation of the Radiosensitiveness of Epithelial Cancers (Rôle de l'histologie dans l'appréciation de la radiosensibilité des cancers épithéliaux). A. Lacassagne. Paris Méd., XIII, 1923, p. 376.*

Mixed tumors.—Laurell collects several radiologically examined true mixed tumors of the pelvis, mediastinum, etc., described in the literature, in only two of which diagnoses were made pre-operatively. He dwells on a case of retroperitoneal teratoma which he himself roentgenologically diagnosed in 1919 and in which the finding of an irregular mass of bone, a cyst the size of an orange, and a tooth with visible root canal, enabled him to make the diagnosis.

He thinks that roentgenologists should keep the existence of such mixed tumors in mind during the roentgen examination of the inner organs of the trunk, which, owing to the occurrence of bone and tooth elements, can be fairly well diagnosed. Such dental remnants may be quite free in the tumors or embedded in a matrix of bone, and they may also occur without the coincident presence of a tumor. If mixed tumors do not contain tooth or other bony elements, they cannot be diagnosed with certainty. It is sometimes possible to make out the shape of the tumor, especially when it is in the thorax and surrounded by transparent parenchyma. The genuine mixed tumor is generally round in shape. —*The Roentgenology of True Mixed Tumors of the Trunk (Ein Beitrag zur Roentgenologie der echten Mischgeschwuelste des Rumpfes). H. Laurell. Acta Radiologica, Stockholm, I, Fasc. IV, p. 406.*

Classification of osteogenesis imperfecta.—Osteogenesis imperfecta is a disease characterized by a congenital defect in the evolution of the osteoblast and recognized clinically by defective ossification of the cranium and a multiplicity of fractures resulting from trivial causes. The author has classified the disease from the clinical aspect into four varieties, that occurring (1) in the fetus, (2) in the infant, (3) in the child or adolescent, and (4) in middle or late

life. In the fetal form the child is stillborn or may survive for only a short time. Numerous fractures of the ribs and other long bones are usually shown, and the lower extremities are deformed and shortened in consequence. The ossification of the skull is very incomplete and in extreme cases the cranial vault is nothing more than a membraneous sac, with a few small, thin, isolated plates of bone corresponding to the normal ossification centers, whilst the base is shorter than usual in the antero-posterior direction. Scattered osseous plates and patches help to fill in the spaces which separate the immature flat bones of the skull. These bone islands are the forerunners of the numerous wormian bones which are a conspicuous feature of the completely ossified skull of this disease. The infantile type is the continuation of the fetal disease in cases which survive their birth and live for months or a few years. It represents a less severe form of the disease than the fetal type. The disease in childhood is quite different from the other two and cases which belong to it have commonly been described as idiopathic fragilitas ossium. The infant is apparently healthy at birth and has a normal childhood except that fractures of the long bones occur at frequent intervals from very slight causes. There is often some evidence of defective cranial ossification. In less aggravated conditions the liability to fracture seems gradually to wear itself out as maturity is reached. A strong familial tendency is often present. Osteogenesis imperfecta in an active state is of rare occurrence in late life. There is no doubt that the foundation is laid in early intra-uterine life, and that the causal defect is present in the fetus even in those cases in which the first signs of trouble do not appear until after birth. The less pronounced that defect the greater is the probability that its signs will be deferred until the individual is able to get about, and is exposed to the ordinary slight traumatisms of a healthy life. Recovery is not necessarily permanent and recurrence may take place when general conditions are unsatisfactory.

The fractures are mainly subperiosteal and the earlier they appear the greater is the liability to them. They unite readily and the callus is much more dense than the rest of the bone. Instances of non-union are not uncommon. The small amount of pain and inflammation present may be explained by the subperiosteal character of the fracture, causing little or no laceration of the soft tissues, and by the atrophic condition of the bone substance. Deformity, which in the lower extremities is often considerable, may be due to bending of the bones from an in-fracture of the thin fragile cortex at one portion of its circumference and not to the flexibility of a softened osseous tissue.

The first marked departure from the normal process of ossification is the formation of trabeculæ by the calcification of cartilage and their extension by metaplasia of the adjoining connective tissue of the marrow. Intimately associated with this and without doubt the cause of it, is the complete absence of rows of osteoblasts. The third important departure from the normal is the production of cartilage cells by the periosteum instead of osteoblasts.

The fragile character of the bone depends on (1) the absence of cortex or its fragmentary nature and exceeding thinness when present; (2) the sparse, delicate and widely separated trabeculæ, honeycombed by closely set spaces, and (3) the nature of the osseous structure.

The article is well illustrated by roentgenograms, photographs of anatomic specimens and photomicrographs.

J. D. CAMP, M.D.

Osteogenesis Imperfecta. R. L. Knaggs. Brit. Jour. Surg., XI, No. 44, 1924, p. 737.

Experiments to determine effects of X-rays.—Besides the local effect on the individual cell, the remote effects of the X-rays on the body as a whole, are, to a marked degree, responsible for their therapeutic success or failure. Review of the humoral-pathological changes, following radiation, relate so far as reported to: Blood coagulation, fibrinogen content, immune substances, sedimentation time of the erythrocytes, serum albumin content, changes in the blood cells, blood sugar and uric acid contents, bilirubin level. Confirmatory experiments by the authors are also reported in regard to the character of the coagulation of blood, the lipoid content, the antitryptic serum litre, the sedimentation time of the erythrocytes, the oxygen-combining power of venous blood, the serum albumin content—under the influence of X-rays. In the reported experiments the incompleteness of the roentgenological technical data is evident, and conclusions as to the actual amount of energy absorbed, therefore, cannot be drawn; but just because of this, the effect of the X-rays probably is dependent upon the conditions investigated. Furthermore, the patients were examined from one to a few days following radiation, and observations extending over a longer period of time would be especially valuable. Finally, control tests as to the effect of X-rays on the healthy body are lacking. But the author, of course, cannot be criticized for this.

We refrain from quoting results of the experiments. Because of the small number of patients thus examined and because of the variety of the conditions treated, they can be misleading and subject to doubt and criticism. We only state that under the influence of X-rays, marked

changes took place in the conditions under investigation.

In further metabolic examinations observations were made as to the basal metabolism and total metabolic activities. The objections mentioned above correspondingly apply to these experiments. Besides, the ill-feeling of the patient following X-ray treatment—radiation sickness—influences the results.

We, therefore, shall not dwell on their results nor on the theoretical considerations deduced therefrom. The authors are convinced that, first of all, the cells under the influence of the rays undergo constitutional and functional changes, which subsequently extend to the body juices. The fact that the changes thus found vary, is surely accounted for by various reasons, of some of which the authors are aware.

As interesting as such experiments are, and as welcome as any additional information on the subject may be, the work is after all of only relative value, and because of its highly inconsistent results, is misleading and, therefore, perhaps harmful to our science.

HANS A. JARRE, M.D.

The Influence of X-rays on Body Juices and Metabolism of the Human Organism. A. Mahnert and H. Zacherl (Graz). Strahlentherapie, XVI, No. 2, 1923, p. 163.

Cardiac examination.—This author reviews the work done in this field, preference being given by the author to the seven-foot teleoroentgenogram and the transverse linear measurements, over the more complicated methods. He concludes that: (1) determination of the size of the heart and great vessels is of great value in clinical medicine; (2) the roentgenologic method is the most accurate means of obtaining such information; (3) the seven heart plate is the most practical and useful method so far devised for obtaining the outline of the heart and great vessels for measurement; (4) by means of the roentgen-ray examination valuable additional information concerning the type of cardiac disease can be obtained.

W. W. WATKINS, M.D.

The Value of Roentgen-ray Measurements in Cardiac Examination. David S. Dann. Jour. of Mo. St. Med. Assn., Oct., 1923, p. 343.

Laryngeal X-ray treatment.—History of a man who had had X-ray treatment for lupus vulgaris of the face (left cheek and ear) and enlargement of the glands of the left side of the neck, which had been mistaken for tuberculous lymphoma. He received two doses of 20X under 4 mm. aluminum for the cervical glandular involvement, while the lupus was treated only once. Two days after the second treatment he suddenly developed respiratory embarrassment, and death occurred from asphyxia. Tracheotomy was performed too late. Autopsy findings: Carcinoma of the left sinus piriformis and carcinomatous glandular metastases. Edema of larynx.

The title of the paper appears incorrect, because we are not dealing with a real injury to the larynx by X-rays as such. Judging from the astonishment of the author as to the development of edema of the glottis and his erroneous diagnosis, his experience with irradiation of the larynx appears to be very limited. I would advise him to have always in readiness and at the bedside of the patient who has had laryngeal X-ray treatment, a tracheotomy outfit, a custom always practiced by us, as well as to refer cases of tuberculous lymphoma and laryngeal carcinoma to the surgical roentgenologist, even if admitted through the dermatological clinic.

HANS A. JARRE, M.D.

Concerning the Question of Injuries to the Larynx by X-rays. H. Schmitz (Bonn). Strahlentherapie, XVI, No. 1, 1923, p. 144.

Treatment of uterine carcinoma.—Report of cases treated at the City Hospital, Stettin, from 1915 to 1920. Practically all the cases treated were inoperable. The author recommends combined radium and X-ray therapy: 5-10,000 mg. hours radium bromide in 2-3 series at four weeks' interval each, X-ray treatment according to Seitz-Wintz. The Dessauer-Warnekros method, used over a period of one year, proved unsatisfactory.

HANS A. JARRE, M.D.

Results of the X-ray Therapy of Carcinoma of the Uterus. E. Mühlmann (Stettin). Strahlentherapie, XVI, No. 1, 1923, p. 137.

An opaque substance.—Attention is called to the fact that strontium salts usually contain soluble barium compounds, which, as is well known, are poisonous. The firm of E. Merck, therefore, advises the following test:

Five g. of strontium bromatum, dissolved in 100 c.c. of distilled water, is mixed with 5 c.c. of a neutral potassium chromate solution 1:20; within one hour no precipitate is supposed to occur.

Merck is carrying pure strontium bromide for roentgenological examinations.

HANS A. JARRE, M.D.

The Use of Strontium Bromatum as an Opaque Substance. Muenchener Medizinische Wochenschrift, March, 1924, No. 13, p. 421.